

Project Name: Mealybug Efficacy

New		Ongoing		Completed	X	Duration if ongoing or completed:	2004, 2005 2008 - 2012
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Project Description:

During the 2003 IR-4 Ornamental Horticulture Workshop certain studies were designated “Super A” to start devoting time and resources to groups of studies with the same general goal. Researching new and existing pest management tools for mealybugs was one set. This concept then morphed into high priority projects. Mealybugs, particularly newly invasive species, present difficulties for growers and landscape managers. While there are several tools in different classes, product efficacy is often unknown for newly invasive species or on mealybugs of new ornamental horticulture crops. Screening for mealybug efficacy initially occurred in 2004 and 2005 and then began again in 2008 with experiments continuing through 2012.

Research Project Abstract (if available):

Abstract from 2016 Scale & Mealybug Efficacy Summary

Managing scale and mealybug insects presents unique challenges. Products with contact modes of action have to be applied at specific timings in order to reach the most susceptible crawler stages. Products with systemic modes of action may work well for certain species and not others based on application timing and whether the insect feeds within phloem or xylem. In 2003, IR-4 initiated a high priority project to determine efficacy of several insecticides on several scale and mealybug species so data can be obtained to add appropriate species to existing registrations.

All products tested on citrus mealybug and Mexican mealybug, including Aria, Flagship, Safari, Talus, and TriStar, generally provided good to excellent efficacy on these species. A trial on Madeira mealybug showed excellent control when TriStar was mixed with Capsil surfactant and poor control without Capsil. NNI-0101, Safari and Talus provided good to excellent control of this species, while A16901B provided mediocre efficacy when applied as drench but good when applied as foliar treatment. Phormium mealybug control was good to excellent with all neonicotinoids tested – Flagship, Safari and TriStar. Good to excellent efficacy on Rhizoecus root mealybug was obtained with A16901B, Aria, Kontos, MBI-203, MBI-205 and Safari in single trials.

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

Citrus Mealybug (<i>Planococcus citri</i>)	Phormium Mealybug (<i>Balanococcus diminutus</i>)
Madeira Mealybug (<i>Phenacoccus madeiresis</i>)	Rhizoecus hibisci (<i>Rhizoecus hibisci</i>)
Mexican Mealybug (<i>Phenacoccus gossypii</i>)	

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

Coleus, Flamenettle (<i>Coleus sp.</i>)	Parapara or Birdcatcher tree (<i>Pisoniabrunoniana</i>)
French marigold (<i>Tagetespatula</i>)	Rhapisrobusta (<i>Rhapisrobusta</i>)
New Zealand Flax (<i>Phormium sp.</i>)	Zinnia (<i>Zinnia sp.</i>)
Rose (<i>Rosa sp.</i>)	

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

A16901B	Grandevo (MBI203) DF	Orthene TTO	SuffOil X
Acelepryn	Hachi-Hachi	Precise Acephate	Talstar NF
Aria 20SG	Kontos	QRD 400	Talus 40SC
Distance	Marathon II	Rycar	Talus 70DF
Flagship 25WG	Merit 2F	Safari 20SG	TriStar 30SG
Flagship 0.22G	Mesurool 75-W	Safari 2G	TriStar 70WSP
			<i>Verticillium lecanii</i>

Product Registration and Research Status			
	Fully Screened (also includes standards)	Partially Screened through IR-4 ¹	Need Data for Additional Species ?
Labeled for Mealybugs Generally & Commercialized	Flagship 25WG Onyx Orthene TTO Precise Acephate Scimitar CS Sun Spray Ultra-Fine oil Talstar NF Talus 40SC Talus 70DF Ultra Pure Oil	Aria 20SG Distance Flagship 0.22G Grandevo (MBI203) DF Kontos Safari 20SG *	Celero 16WSG Botanigard 22WP EcoTrol Marathon II M-Pede Preferal Rycar * Safari 2G SuffOil X TriStar 30SG Xxpire
Labeled for Mealybugs Generally But NOT Commercialized			
Labeled for Specific Mealybugs & Commercialized			
Labeled for Specific Mealybugs but NOT Commercialized			
Not yet registered or labeled for Mealybugs		A16901B	Hachi-Hachi <i>Verticilliumlecanii</i>
No longer available for development for Mealybugs	Acelepryn QRD 400		
* IR-4 Data contributed to registration decision – either adding pest to label or not pursuing further research			
1 At least one species screened fully			
2 Product not available for production ornamentals			

Area	Characteristic	Pro	Con
Availability & effectiveness of alternative management tools	Very few new tools for screening		x
Damage potential of target			
Performance and crop safety of proposed products (from other systems)	Mealybugs tend to be managed well with a few exceptions Several IRAC classes are available for resistance management		X
Compatibility with IPM, resistance management programs			
Economics			
Geographic distribution			
Manufacturer interest in labeling products			
Other			

IR-4 Efficacy Trials to Date

Average rating on a scale of 1 – 5 with 1 = 0 to about 50% efficacy (not effective) and 5 = 95 to 100 efficacy (very effective); minimum to maximum rating; number of trials (See table on next page). For product/insect combinations that are blank, IR-4 has not screened this combination.

'Labeled' indicates that this insect species or genera is listed on the label. A rating of 2 or lower is considered unacceptable efficacy (*red text*). A rating of 3 or higher is considered commercially acceptable (black text). Non-labeled, completed product/insect combinations (3 or more trials) with an average rating of 3 or higher are highlighted with *green text*. For insect/product combinations that are blank, IR-4 has not screened this combination.

Product (Active Ingredients)	Citrus Mealybug (<i>Planococcus citri</i>)	Madeira Mealybug (<i>Phenacoccus madeiresis</i>)	Mexican Mealybug (<i>Phenacoccus gossypii</i>)	Phormium Mealybug (<i>Balanococcus diminutus</i>)	Rhizoecus hibisci (<i>Rhizoecus hibisci</i>)
A16901B 45WG (Cyantraniliprole + thiamethoxam)	4.5 (4 - 5) n2 Labeled	3.4 (1 - 5) n5 Labeled			5.0 (5 - 5) n1 Labeled
Acelepryn (aka DPX-E2Y45) 1.67 (Chlorantraniliprole)					1.0 (1 - 1) n1
Aria 50SG (Flonicamid)	3.0 (1 - 5) n3 Labeled		5.0 (5 - 5) n1 Labeled		4.0 (4 - 4) n1
Distance (Pyriproxyfen)	2.3 (1 - 3) n3 Labeled	2.0 (1 - 3) n2 Labeled			
Flagship 0.22G (Thiamethoxam)		2.3 (1 - 3) n3 Labeled			
Flagship 25WG (Thiamethoxam)	4.4 (4 - 5) n5 Labeled	3.3 (2 - 5) n4 Labeled	4.0 (4 - 4) n1 Labeled	4.0 (4 - 4) n1 Labeled	
Grandevo (MBI 203 DF) (Chromobacterium subtsugae NRRL B-30655)	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n1 Labeled			4.0 (4 - 4) n1
Hachi-Hachi EC (Tolfenpyrad)		5.0 (5 - 5) n1			
Horticultural Oil (Horticultural Oil)		5.0 (5 - 5) n1			
Kontos (BYI 8330 240SC) (Spirotetramat)	1.5 (1 - 2) n2 Labeled	4.0 (2 - 5) n3 Labeled			3.8 (3 - 5) n4 Labeled
Marathon II (Imidacloprid)	1.0 (1 - 1) n2 Labeled				
MBI 205 (MBI205)	2.0 (2 - 2) n1	5.0 (5 - 5) n1			2.0 (2 - 2) n1
Merit 75WP (Imidacloprid)		1.0 (1 - 1) n1 Labeled			
Mesurool 75-W (Methicarb)	3.0 (3 - 3) n1				
Natural Solutions - V. lecanii (Verticillium lecanii)	3.0 (3 - 3) n1				
Orthene TTO 97 (Valent) (Acephate)		5.0 (5 - 5) n3 Labeled	5.0 (5 - 5) n1 Labeled		1.0 (1 - 1) n1
Precise Acephate (Acephate)				1.0 (1 - 1) n1 Labeled	
QRD 400 (Extract of Chenopodium ambrosioides)	1.5 (1 - 2) n2	3.0 (3 - 3) n1			
Rycar (SP3009/NNI-0101) (Pyrifluquinazon)	5.0 (5 - 5) n1 Labeled	4.0 (3 - 5) n2 Labeled			
Safari 20SG (Dinotefuran)	3.9 (1 - 5) n7 Labeled	4.0 (3 - 5) n2 Labeled	5.0 (5 - 5) n1 Labeled	5.0 (5 - 5) n2 Labeled	4.5 (4 - 5) n2
Safari 2G (V-10112 2G) (Dinotefuran)		3.5 (2 - 5) n2 Labeled			

Product (Active Ingredients)	Citrus Mealybug (<i>Planococcus citri</i>)	Madeira Mealybug (<i>Phenacoccus madeirensis</i>)	Mexican Mealybug (<i>Phenacoccus gossypii</i>)	Phormium Mealybug (<i>Balanococcus diminutus</i>)	Rhizoecus hibisci (<i>Rhizoecus hibisci</i>)
SuffOil X (Synergy) (Petroleum Oil)		3.0 (3 - 3) n1 Labeled			
Talstar NF (Bifenthrin)	3.0 (3 - 3) n2 Labeled				
Talus 40SC (Buprofezin)	3.8 (3 - 4) n5 Labeled	5.0 (5 - 5) n1 Labeled	5.0 (5 - 5) n1 Labeled		
Talus 70DF (Buprofezin)	3.0 (3 - 3) n1 Labeled	4.5 (4 - 5) n2 Labeled			
TriStar 30SG (Acetamiprid)	5.0 (5 - 5) n1 Labeled	4.0 (4 - 4) n1 Labeled	5.0 (5 - 5) n1 Labeled		
TriStar 70WSP (Acetamiprid)	5.0 (5 - 5) n4 Labeled	4.0 (4 - 4) n1 Labeled		4.0 (4 - 4) n1 Labeled	

Foliar Applied Insecticides (active ingredients)	IRAC Class	Registered Use Site(s)	Knock Down	Residual Control (days)	REI	Scale-Mealybug Efficacy				Life Stages			Treatment Program			
						Armored Scales	Cushion Scales	Soft Scales	Mealybugs	Immatures	Pupae	Adults	A	B	C	D
													Aggressive	Maintenance w/out biologicals	Maintenance with Biologicals	Maintenance prior to biologicals
Aria (flonicamid)	9c	G, I, N	M	7-14	12 h	?	?	?	G-E	x	?	x	?	B	C	D
Astro, Permethrin.Pro, etc. (permethrin)	3A	G, I	F	5-7	12 h	?	?	?	?	x	?	x	?	B	NO	NO
Aza-Direct, Molt-X, etc. (azadirachtin)	18B	G, I, N, S	S	7	4 h	?	?	?	?	x	?	?	?	?	C	D
BotaniGard, Mycotrol-O, Naturalis L (<i>Beauveria bassiana</i>)	M	G, I, N, S	M	3	4 h	P	?	?	?	x	x	x	?	B	C *	D
Conserve SC, Entrust (spinosad)	5	G, L, N, S	F	5	4 h	?	?	?	?	x	?	x	A	B	C **	D
Decathlon (cyfluthrin)	3A	G, I, N	F	7	12 h	?	?	?	?	x	?	x	?	B	NO	NO
Cygon, Dimethoate (dimethoate)	1B	N	F	5-7?	48 h	G	?	?	?	x	?	x	?	B	NO	NO
Discus Tablet (cyfluthrin+imidacloprid)	3A + 4A	N	F	5-7	12 h	?	?	G	?	x	?	x	?	B	NO	NO
Distance (pyriproxyfen)	7D	G, I, L, S	S	?	12 h	P-E	P-E	P-F	P-E	x	x	?	?	B	NO	NO
Duraguard, Dursban (chlorpyrifos)	1B	G, N	F	5-7	24 h	F	?	P	?	x	?	x	?	B	NO	NO
Ecotec, Ecotrol (rosemary and peppermint oils)	-	G, N	?	?	?	?	?	?	?	x	?	x	?	?	?	?
Enstar AQ (kinoprene)	7A	G, I, L, S	S	?	4 h	?	?	?	?	x	?	x	?	?	C	D
Flagship 25WG (thiamethoxam)	4A	G, I, L, N, S	F	7-14	12 h	P-E	P-G	F-E	E	x	?	x	A	B	?	?
Grandevo, MBI-203 DF (<i>Chromobacterium subsugae</i> strain PRAA4-1 ^T)	-	G, N	S	?	4 h	?	?	?	P-G	x	?	x	?	?	?	?
Hachi-Hachi EC (tolfenpyrad)	21A	G	F	7-14	12 h	?	?	?	G	x	?	x	A	B	NO	?
Judo (spiromesifen)	23	G, N, S	M	7	12 h	?	?	?	?	x	?	x	A	B	?	?
Kontos, BYI-8330 (spirotetramat)	23	G, I, N	S	7-14	24 h	P-E	P-E	E	G-E	x	?	x	A	B	?	?
Mainspring, A20520A, DPX-HGW86 (cyantraniliprole)	28	G, I	F	?	4 h	P-E	?	E	?	?	?	?	?	B	?	?
Malathion	1B	G, N	F	5-7	12 h	?	?	?	?	x	?	x	?	B	NO	NO
Marathon (imidacloprid)	4A	G, I, N	F	?	12 h	?	?	?	?	x	?	x	?	B	NO	NO
Mavrik (fluvalinate)	3	G, I, N	F	14	12 h	?	?	?	?	x	?	x	?	B	NO	NO
Met 52, Tick Ex (<i>Metarhizium anisopliae</i> F52)	-	G, N	M	5-7	4 h	?	E	?	?	x	?	x	?	?	?	?
M-Pede, Safer Soap (potassium salts of fatty acids)	-	G, I, N	F	Contact	12 h	?	?	?	?	x	?	?	A	B	C **	D
NoFly WP (<i>Paecilomyces fumosoroseus</i> strain FE 9901)	-	G	M	3-7	4 h	P - G	P - G	P - G	P - G	x	?	x	A	B	C	D
Orthene T&O, Acephate 97 UP (acephate)	1B	G, N	F	7	24 h	P-E	F-G	P-G	E	x	?	x	A	B	NO	NO
Preferal, PFR-97 (<i>Isaria fumosoroseus</i>)	-	G, L, N, S	S	Contact	4 h	?	?	?	?	x	?	x	A	B	C	D
Prentox Pyronyl Crop Spray, Pyrenone Crop Spray, etc. (pyrethrins + PBO)	3A + -	G, N	F	Contact	12 h	?	?	?	?	x	?	x	?	B	NO	NO

Foliar Applied Insecticides (active ingredients)	IRAC Class	Registered Use Site(s)	Knock Down	Residual Control (days)	REI	Scale-Mealybug Efficacy				Life Stages			Treatment Program			
						Armored Scales	Cushion Scales	Soft Scales	Mealybugs	Immatures	Pupae	Adults	A	B	C	D
													Aggressive	Maintenance w/out biologicals	Maintenance with Biologicals	Maintenance prior to biologicals
Rycar, NNI-0101 (pyrifluquinazon)	UN	G	?	10	12 h	P-E	E	?	G-E	x	?	x	?	B	?	?
Safari 20SG (dinotefuran)	4A	G, N	M	7	12 h	P-E	P	P-E	F-E	x	?	x	A	B	NO	NO
Scimitar GC (lambda-cyhalothrin)	3A	G, N, S	F	7	24 h	?	?	?	?	x	?	x	?	B	NO	NO
Sorbishield 90 (sorbitol octanoate)	-	G, N	?	Contact	24 h	?	?	?	?	x	?	x	?	B	?	?
Sucrashield (sucrose octanoate)	-	G, N	?	Contact	48 h	?	?	?	?	x	?	x	?	B	?	?
Supracide (methidathion)	1B	N	F	?	48 h	?	?	?	?	x	?	x	?	B	NO	NO
Surround WP (kaolin)	-	G	?	Contact	4 h	?	?	?	?	x	?	x	?	B	C	D
Talstar, Onyx (bifenthrin)	3A	G, I, N	F	7	12 h	P-E	?	P	G	x	?	x	?	B	NO	NO
Talus (buprofezin)	16	G, L, N, S	S	14	12 h	P-E	P-E	P-G	F-E	x	?	x	A	B	C	D
Tame (fenpropathrin)	3A	G, I, L, N, S	F	7	24 h	?	?	?	?	x	?	x	?	B	NO	NO
Triact, Trilogy Neem Oil (extract of neem oil)	18B	G, N	S	7	4 h	G	?	?	?	x	?	?	?	?	C	D
TriStar (acetamiprid)	4A	G, L, N, S	F	?	12 h	P-E	G-E	G-E	G-E	x	?	x	A	B	NO	D
Ultra pure oil, SuffOil-X, etc. (paraffinic oil)	-	G, N	F	Contact	4 h	P-E	P-E	?	E	x	x	x	A	B	C**	D
XXpire (spinetoram+sulfoxaflor)	5+4C	G, N	F	14	12 h	F-E	P-E	P-G	?	x	?	?	?	B	?	?
Experimental Products																
A16901B (cyantraniliprole + thiamethoxam)	28 + 4A	TBD	?	?	?	E	P	P	E	x	?	x	?	?	?	?
Aloft (bifenthrin + clothianidin)	3A + 4A	TBD	F	?	12 h	P-G	?	?	?	x	?	x	?	?	?	?
Arena, Celero 16WG (clothianidin)	4A	TBD	?	?	12 h	P-E	P	F-E	?	x	?	x	?	?	NO	NO
BAS 440	-	TBD	?	?	?	?	?	?	?	?	?	?	?	?	?	?
BYI-2960	-	TBD	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Facin (<i>Chenopodium ambrosioides</i>)	-	TBD	?	?	?	?	?	?	F-G	x	?	x	?	?	?	?
GF-2626 1SC (sulfoxaflor)	-	TBD	?	?	?	F-E	P-G	?	?	x	?	x	?	?	?	?
IKI-3106	-	TBD	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Venerate, MBI-206 (<i>Burkholderia</i> sp. strain A396)	-	G, N	S	?	4h	?	?	?	E	x	?	x	?	?	?	?
Milstop ^a (potassium bicarbonate)	NC	G, I, L, N, S	?	?	1 h	?	?	?	G	x	?	?	?	?	?	?
QRD 416 (oil extract from <i>Chenopodium</i> sp.) ^b	-	TBD	?	?	?	?	?	?	?	x	?	x	?	?	?	?

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

Knockdown: Fast (< 1 day), Medium (1-7 days), Slow (>7 days).

Efficacy: P = Poor (< 70% control); F = Fair (70% to 85% control); G = Good (85% to 95% control), E = Excellent (>95% control) on immatures and/or adults 1 to 3 weeks after first app.

Residual Control taken from product technical and label info, recommendations on earliest application intervals; Scale, Mealybug Efficacy taken from latest IR-4 efficacy summary draft; Effect on biological control agents for scales/mealybugs taken from Koppert, Biobest and some extension publications/recommendations.

Information presented is based on the best data available on July 17, 2015.



Registered and Experimental Products for Scale & Mealybug Management

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Armored scales: *Aspidiotus cryptomeriae*, *Aterolecanium puteanum*, *Chrysomphalus aonidum*, *Chrysomphalus bifasciculatus*, *Fiorinia externa*, *Fiorinia theae*, *Lepidosaphes camelliae*, *Lepidosaphes ulmi*, *Lepidosaphes yanagicola*, *Melanaspis deklei*, *Phenacaspis pinifoliae*, *Pseudaulacaspis cockerelli* and *Unaspis euonymi*

Cushion scales: *Icerya purchasi*,

Soft scales: *Ceroplastes floridensis*, *Eulecanium cerasorum*, *Lecanium fletcheri* and *Pulvinaria innumerabilis*

Mealybugs: *Balanococcus diminutus*, *Phenacoccus gossypii*, *Phenacoccus madeirensis*, *Planococcus citri* and *Rhizoecus hibisci*

* Results of efficacy trials have been variable for entomopathogens and impact on beneficial organisms is presumed to be less than that of traditional pesticide chemistries but the data are sparse.

** This insecticide is toxic to many BCA's but has a short residual and may be suitable for treating hot spots and re-introducing BCA's soon thereafter.

^a Milstop has a New York 2ee recommendation to control mealybugs, aphids, spider mites, stink bugs and whiteflies.

^b No longer sold or produced. To be replaced by QRD 4.052. New formulation in early development stage, no testing before 2015.