



# Environmental Horticulture Program Research Project Sheet

<https://www.ir4project.org/ehc/ehc-registration-support-research/env-hort-extension-resources/>

Project Name:

Scale Efficacy

New	Ongoing	X	Completed		Duration if ongoing or completed:	2004 – 2015, 2018-2021
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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 scale insects was one set. This concept then morphed into high priority projects. Scale insects, especially armored scale, present difficulties for growers and landscape managers. While there are several tools in different classes, product efficacy is often unknown for many species of new ornamental horticulture crops. Screening for mealybug efficacy initially occurred in 2004 and continued through 2012.

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

*Abstract from 2020 Scale & Mealybug Efficacy Summary*

Managing scale and mealybug insects presents unique challenges. Products with contact modes of action must 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. This research was conducted between 2004 and 2020. This report is a brief summary of available data from 94 experiments received through the IR-4 Environmental Horticulture Program. Several neonicotinoids (Aloft SC/Celero 16WSP, Flagship 0.22G/25WP, Safari 2G/20SG/Transtect 70WSP, and TriStar 30SG/70WSP), insect growth regulators (Distance and Talus 40SC/70DF), and other products were tested against scales and mealybugs. All products tested generally provided excellent control of elongate hemlock scale, cryptomeria scale, gloomy scale, citrus mealybug and Mexican mealybug, generally mediocre to excellent control of false oleander scale, Fletcher scale, Florida wax scale, magnolia scale, and poor control of armored scale. For other species, efficacy levels varied with the active ingredient and method/timing of application. In single trials, Altus, Talus and Ventigra provided good efficacy on cycad scale, while Altus, Pradia, Sarisa and Talus provided good efficacy on lobate lac scale. All products tested on citrus mealybug and Mexican mealybug, including Aria, Flagship, Safari, Talus, and TriStar, generally provided good to excellent control of these species. An experiment on Madeira mealybug showed excellent control when TriStar was mixed with Capsil surfactant, and poor control without Capsil. Rycar, Safari and Talus provided good to excellent control of this species, while A16901B provided mediocre control when applied as drench but good when applied as foliar treatment. Pradia and Ventigra also provided excellent control of Madeira mealybug. Phormium mealybug control was good to excellent with all neonicotinoids tested – Flagship, Safari and TriStar. Good to excellent control of Rhizococcus root mealybug was obtained with A16901B, Aria, Kontos, MBI-203, MBI-205 and Safari in single experiments. ISM555 provided good control of crapemyrtle bark scale and Madeira mealybug, while SP3014 provided good control of Madeira mealybug, in single trials. Seven recently registered products (Altus, Mainspring, Pradia, Rycar, Sarisa, Ventigra and XXpire) looked promising on several species based on their efficacy relative to standards. Further research is needed to obtain additional efficacy data to recommend actions to register or amend labels for these pests.

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

<p>Calico Scale(<i>Eulecanium cerasorum</i>)  Cottony Cushion Scale(<i>Icerya purchasi</i>)  Cottony Maple Scale (<i>Neopulvinaria innumerabilis</i>)  Elongate Hemlock (<i>Fiorinia externa</i>) and Cryptomeria Scales  Euonymus Scale (<i>Unaspis euonymi</i>)  False Florida Red Scale (<i>Chrysomphalus bifasciculatus</i>)  False Oleander Scale(<i>Pseudaulacaspis cockerelli</i>)  Fletcher Scale (<i>Parthenolecanium fletcheri</i>)</p>	<p>Florida Wax Scale(<i>Ceroplastes floridensis</i>)  Gloomy Scale (<i>Melanaspis tenebricosa</i>)  Holly Pit Scale (<i>Asterolecanium puteanum</i>)  Indian Wax Scale (<i>Ceroplastes ceriferus</i>)  Magnolia Scale (<i>Neolecanium cornuparvum</i>)  Oystershell Scale (<i>Diaspidiotus ostreiformis</i>)  Pine Needle Scale (<i>Phenacaspis pinifoliae</i>)  Tea Scale (<i>Fiorinia theae</i>)  Wax Myrtle Scale (<i>Melanaspis deklei</i>)</p>
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Florida Red Scale ( <i>Chrysomphalus aonidum</i> )	Winged Euonymus Scale ( <i>Lepidosaphes yanagicola</i> )
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Target Crops (list tested crops if ongoing or completed project)	
Aucuba ( <i>Aucuba sp.</i> )	Magnolia, Southern ( <i>Magnolia grandiflora</i> )
Camellia, Japanese ( <i>Camellia japonica</i> )	Maple, Red ( <i>Acer rubrum</i> )
Euonymus sp.	Maple, Silver ( <i>Acer saccharinum</i> )
Fir, Fraser ( <i>Abies fraseri</i> )	<i>Pinussylvestris</i>
Heavenly Bamboo ( <i>Nandinadomestica</i> )	Pittosporum ( <i>Pittosporum tobira</i> )
Holly ( <i>Ilex sp.</i> )	Purpleleaf Wintercreeper ( <i>Euonymus radicans</i> )
Holly, Blue ( <i>Ilex x meserveae</i> )	Silverbell Carolina ( <i>Halesiacarolina var. carolina</i> )
Holly, Chinese ( <i>Ilex cornuta</i> )	Spindle Tree ( <i>Euonymus japonicus</i> )
Honey Locust ( <i>Gleditsia triacanthosinermis</i> )	<i>Ternstroemia gymnanthera</i>
Indian Hawthorn ( <i>Raphiolepis indica</i> )	Wax Myrtle ( <i>Myrica cerifera</i> )
Japanese Aralia ( <i>Fatsia japonica</i> )	Winged Burning Bush ( <i>Euonymus alatus</i> )
Japanese Zelkova ( <i>Zelkova serrata</i> )	Yew ( <i>Taxus media</i> )
Lilac, Common ( <i>Syringa vulgaris</i> )	

Target Product(s)(list tested products or numbered compounds if ongoing or completed project)				
A16901B	Cyclanilprole	Horticultural Oil	Orthene TTO	Talus 40SC
Acephate Pro 75WSP	Cygon 2E	Judo 2SC	QRD 452	Talus 70DF
Aloft SC	Diazinon 4E	Kontos	Rycar	Talus WP
Altus	Discus	Mainspring 200SC	Safari 20SG	Triact
Arena 50WDG	Distance	Marathon II	Safari 2G	TriStar 30SG
AzaGuard	Flagship 25WG	Merit 2F	SuffOil X	TriStar 70WSP
BAS 440 i	Flagship 0.22G	MOI 201	Sun Spray Ultra-Fine	Ultra Pure Oil
BotaniGard 22WP	GF-2626 1SC	Onyx	oil	XXpire
Celero 16WSG			Talstar NF	

Product Registration and Research Status			
	Fully Screened (also includes standards)	Partially Screened through IR-4 <sup>1</sup>	Need Data for Additional Species ?
Labeled for Scale Generally & Commercialized	Acephate Pro 75WSP Cygon 2E Diazinon 4E <b>Flagship 25WG *</b> Orthene TTO Sun Spray Ultra-Fine oil Talstar NF Talus 40SC Talus 70DF Ultra Pure Oil	Aria 20SG Discus Distance <b>Kontos*</b> <b>Safari 20SG *</b> <b>TriStar 30SG *</b>	Aloft SC <sup>2</sup> Arena 50WDG <sup>2</sup> EcoTrol Hachi-Hachi M-Pede <b>Rycar *</b> Safari 2G SuffOil X <b>Xxpire *</b>
Labeled for Specific Scale & Commercialized	Scimitar CS	Onyx	
Labeled for Specific Scale but NOT Commercialized			
Not yet registered or labeled for Scale		A16901B Flagship 0.22G	BotaniGard 22WP Marathon II Merit 2F <sup>2</sup>
No longer available for development for Scale	Acelepryn <b>Celero 16WSG *</b> GF-2626 1SC	MOI 201 QRD 452	
* 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)	Need more armored scale data	X	
	Need more lac scale data	X	
Compatibility with IPM, resistance management programs	Several IRAC classes are available for resistance management		X
Economics			
Geographic distribution			
Manufacturer interest in labeling products			
Other	Successful project with data clearly contributing to expanded labels	X	
	Some labels are general, some are specific	X	X
	Sites can be difficult to locate		X

**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.

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MOA	Product (Active Ingredients)	Camelia Scale ( <i>Lepidosaphes camelliae</i> )	Cottony Cushion Scale ( <i>Icerya purchasi</i> )	Cottony Maple Scale ( <i>Neopulvinaria innumerabilis</i> )	Crape Myrtle Bark Scale ( <i>Eriococcus lagerstroemia</i> )	Euonymus Scale ( <i>Unaspis euonymi</i> )	False Florida Red Scale ( <i>Chrysomphalus bifasciculatus</i> )
IRAC 1B	Acephate Pro 75 WSP (Acephate)					5.0 (5 - 5) n1 Labeled	
	Cygon 2E (Dimethoate)					3.7 (3 - 5) n3 Labeled	
	Diazinon 4E (Diazinon)					5.0 (5 - 5) n1 Labeled	
	Orthene TTO 97 (Valent) (Acephate)	1.0 (1 - 1) n1 Labeled	3.0 (3 - 3) n2 Labeled			3.0 (2 - 4) n2 Labeled	
IRAC 3A	Talstar Flowable Insecticide/Miticide (Bifenthrin)			1.0 (1 - 1) n1			
IRAC 4A	Arena 50WDG (Clothianadin)	1.0 (1 - 1) n1					
	Celero 16WWSG (Clothianidin)		1.0 (1 - 1) n1 Labeled				
	Flagship 0.22G (Thiamethoxam)	1.0 (1 - 1) n1	3.3 (1 - 5) n4			2.2 (1 - 4) n6	
	Flagship 25WG (Thiamethoxam)	1.0 (1 - 1) n1 Labeled	4.5 (4 - 5) n2 Labeled	3.0 (3 - 3) n1 Labeled		2.3 (1 - 4) n8 Labeled	5.0 (5 - 5) n1 Labeled
	Marathon II (Imidacloprid)			1.0 (1 - 1) n1 Labeled			
	Safari 20SG (Dinotefuran)	1.0 (1 - 1) n1 Labeled	3.0 (1 - 5) n4 Labeled	1.0 (1 - 1) n2 Labeled	2.0 (2 - 2) n1 Labeled	3.8 (1 - 5) n11 Labeled	5.0 (5 - 5) n1 Labeled
	Safari 2G (Dinotefuran)	1.0 (1 - 1) n1 Labeled	5.0 (5 - 5) n2 Labeled			4.0 (2 - 5) n5 Labeled	
	TriStar 30SG (Acetamiprid)	1.0 (1 - 1) n1 Labeled	5.0 (5 - 5) n2 Labeled	1.0 (1 - 1) n1 Labeled		2.6 (1 - 5) n8 Labeled	3.0 (3 - 3) n1 Labeled
	TriStar 70WSP (Acetamiprid)		3.0 (3 - 3) n1 Labeled				
	TriStar 8.5SL (Acetamiprid)						
IRAC 4A + IRAC 28	A16901B 45WG (Thiamethoxam + cyantraniliprole)	1.0 (1 - 1) n1	2.0 (1 - 5) n4			2.3 (1 - 5) n3	
IRAC 4A + IRAC 3	Aloft SC (Clothianadin + bifenthrin)					4.0 (3 - 5) n2 Labeled	
IRAC 4C	GF-2626 1SC (Sulfoxaflor)		2.0 (1 - 3) n2				
IRAC 4D	Altus (Flupyradifurone)				2.0 (2 - 2) n1 Labeled		

MOA	Product (Active Ingredients)	Camelia Scale ( <i>Lepidosaphes camelliae</i> )	Cottony Cushion Scale ( <i>Icerya purchasi</i> )	Cottony Maple Scale ( <i>Neopulvinaria innumerabilis</i> )	Crape Myrtle Bark Scale ( <i>Eriococcus lagerstroemia</i> )	Euonymus Scale ( <i>Unaspis euonymi</i> )	False Florida Red Scale ( <i>Chrysomphalus bifasciculatus</i> )
IRAC 5 + IRAC 4C	Xxpire 40WG (Spinetoram + sulfoxaflor)	5.0 (5 - 5) n1 Labeled	3.0 (1 - 5) n2 Labeled			3.5 (2 - 5) n2 Labeled	
IRAC 7C	Distance (Pyriproxyfen)	5.0 (5 - 5) n1 Labeled	3.0 (1 - 5) n4 Labeled		<b>2.0 (2 - 2) n1 Labeled</b>	3.9 (1 - 5) n10 Labeled	3.0 (3 - 3) n1 Labeled
IRAC 9B	Rycar (Pyrifluquinazon)		<b>5.0 (5 - 5) n2</b>			<b>2.6 (1 - 5) n7</b>	<b>3.0 (3 - 3) n1</b>
IRAC 16	Talus 40SC (Buprofezin)			<b>1.0 (1 - 1) n1 Labeled</b>		4.3 (3 - 5) n4 Labeled	3.0 (3 - 3) n1 Labeled
	Talus 70DF (Buprofezin)	5.0 (5 - 5) n1 Labeled	3.0 (1 - 5) n4 Labeled		<b>2.0 (2 - 2) n1 Labeled</b>	4.0 (1 - 5) n6 Labeled	
	Talus WP (Buprofezin)					5.0 (5 - 5) n1 Labeled	
IRAC 23	Judo 2SC (Spiromesifen)						
	Kontos (BYI 8330 240SC) (Spirotetramat)	5.0 (5 - 5) n1 Labeled	3.7 (1 - 5) n3 Labeled			<b>2.0 (1 - 3) n3 Labeled</b>	
IRAC 28	Mainspring GNL 200SC (Cyantraniliprole)	<b>1.0 (1 - 1) n1</b>				<b>3.0 (1 - 5) n2</b>	
FRAC NC	BW133 (BW133)				<b>1.0 (1 - 1) n1</b>		
FRAC NC	Horticultural Oil (Horticultural Oil)		<b>2.0 (2 - 2) n1</b>			<b>4.3 (3 - 5) n3</b>	
FRAC NC	MOI 201 (MOI 201)						
FRAC NC	Paraffin Oil (Paraffin Oil)	<b>5.0 (5 - 5) n1</b>					
FRAC NC	Sun Spray Ultra-Fine Spray Oil (Paraffinic oil)					<b>5.0 (5 - 5) n1</b>	
IRAC UN	Triact (Clarified hydrophobic extract of neem oil)					4.0 (4 - 4) n1 Labeled	
IRAC UNE	QRD 452 (Extract of Chenopodium ambrosioides)					<b>3.0 (3 - 3) n1</b>	
unknown	BW238 ES (BW238 ES)				<b>1.0 (1 - 1) n1</b>		
unknown	BW238 WP (BW238 WP)				<b>1.0 (1 - 1) n1</b>		
unknown	ISM-555 (ISM-555, A21377X)				<b>5.0 (5 - 5) n1</b>		
unknown	MBI 203 SC2 (MBI 203)				<b>1.0 (1 - 1) n1</b>		
unknown	MBI 306 (MBI 306)				<b>1.0 (1 - 1) n1</b>		
unknown	RTSA 721 (RTSA 721)				<b>5.0 (5 - 5) n1</b>		
unknown	SP3014 (SP3014)				<b>1.0 (1 - 1) n1</b>		
unknown	V-10433 (V-10433)				<b>1.0 (1 - 1) n1</b>		

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MOA	Product (Active Ingredients)	False Oleander Scale ( <i>Pseudaulacaspis cockerelli</i> )	Fletcher Scale ( <i>Parthenolecanium fletcheri</i> )	Florida Red Scale ( <i>Chrysomphalus aonidum</i> )	Florida Wax Scale ( <i>Ceroplastes floridensis</i> )	Gloomy Scale ( <i>Melanaspis tenebricosa</i> )	Hala Scale ( <i>Thysanococcus pandani</i> )
IRAC 1B	Orthene TTO 97 (Valent) (Acephate)	1.0 (1 - 1) n1 <i>Labeled</i>		1.0 (1 - 1) n1 <i>Labeled</i>	1.0 (1 - 1) n2 <i>Labeled</i>		
IRAC 4A	Arena 50WDG (Clothianadin)				5.0 (5 - 5) n1		
	Celero 16WSG (Clothianidin)			1.0 (1 - 1) n1 <i>Labeled</i>	3.7 (3 - 5) n3 Labeled		
	Flagship 0.22G (Thiamethoxam)	2.0 (2 - 2) n1				5.0 (5 - 5) n1	
	Flagship 25WG (Thiamethoxam)	2.0 (2 - 2) n2 <i>Labeled</i>	3.5 (3 - 4) n2 Labeled	1.0 (1 - 1) n1 <i>Labeled</i>	3.8 (3 - 5) n5 Labeled	5.0 (5 - 5) n1 Labeled	
	Marathon II (Imidacloprid)				5.0 (5 - 5) n1 Labeled		
	Safari 20SG (Dinotefuran)	3.0 (2 - 4) n2 Labeled	2.0 (2 - 2) n2 <i>Labeled</i>	1.0 (1 - 1) n2 <i>Labeled</i>	4.5 (4 - 5) n2 Labeled	5.0 (5 - 5) n1 Labeled	
	Safari 2G (Dinotefuran)	3.0 (3 - 3) n1 Labeled				5.0 (5 - 5) n1 Labeled	
	TriStar 30SG (Acetamiprid)	1.0 (1 - 1) n1 <i>Labeled</i>		1.0 (1 - 1) n1 <i>Labeled</i>	5.0 (5 - 5) n1 Labeled	5.0 (5 - 5) n1 Labeled	
	TriStar 70WSP (Acetamiprid)	1.0 (1 - 1) n1 <i>Labeled</i>	3.0 (3 - 3) n1 Labeled		5.0 (5 - 5) n3 Labeled		
	TriStar 8.5SL (Acetamiprid)	1.0 (1 - 1) n1					
IRAC 4A + IRAC 3A	Discus (Imidacloprid + cyfluthrin)		3.0 (3 - 3) n2 Labeled				
IRAC 4A + IRAC 28	A16901B 45WG (Thiamethoxam + cyantraniliprole)	1.0 (1 - 1) n1				5.0 (5 - 5) n1	
IRAC 4D	Altus (Flupyradifurone)	2.0 (1 - 3) n2 <i>Labeled</i>					3.0 (3 - 3) n1 Labeled
IRAC 5 + IRAC 4C	Xxpire 40WG (Spinetoram + sulfoxafloz)	5.0 (5 - 5) n1 Labeled					
IRAC 7C	Distance (Pyriproxyfen)	2.5 (1 - 5) n4 <i>Labeled</i>	1.0 (1 - 1) n1 <i>Labeled</i>		4.0 (4 - 4) n1 Labeled	5.0 (5 - 5) n1 Labeled	
IRAC 9B	Rycar (Pyrifluquinazon)	2.0 (2 - 2) n1				5.0 (5 - 5) n1	
IRAC 9D	Ventigra Insecticide (Afidopyropen)	1.0 (1 - 1) n2 <i>Labeled</i>					2.0 (2 - 2) n1 <i>Labeled</i>

MOA	Product (Active Ingredients)	False Oleander Scale ( <i>Pseudaulacaspis cockerelli</i> )	Fletcher Scale ( <i>Parthenolecanium fletcheri</i> )	Florida Red Scale ( <i>Chrysomphalus aonidum</i> )	Florida Wax Scale ( <i>Ceroplastes floridensis</i> )	Gloomy Scale ( <i>Melanaspis tenebricosa</i> )	Hala Scale ( <i>Thysanococcus pandani</i> )
IRAC 16	Talus 40SC (Buprofezin)	1.0 (1 - 1) n1 Labeled	2.0 (1 - 3) n2 Labeled		3.0 (2 - 4) n2 Labeled		
	Talus 70DF (Buprofezin)	2.5 (1 - 5) n4 Labeled				5.0 (5 - 5) n1 Labeled	3.0 (3 - 3) n1 Labeled
	Talus WP (Buprofezin)		3.0 (3 - 3) n1 Labeled				
IRAC 23	Kontos (BYI 8330 240SC) (Spirotetramat)	1.0 (1 - 1) n1 Labeled				5.0 (5 - 5) n1 Labeled	
IRAC 28	Mainspring GNL 200SC (Cyantraniliprole)	5.0 (5 - 5) n1					
	Sarisa 50SL (Cyclaniliprole)	1.5 (1 - 2) n2					1.0 (1 - 1) n1
IRAC 28 + IRAC 29	Pradia (Cyclaniliprole + Flonicamid)	2.5 (1 - 4) n2					1.0 (1 - 1) n1
FRAC NC	Paraffin Oil (Paraffin Oil)	4.0 (4 - 4) n1					
FRAC NC	SuffOil X (Synergy) (Petroleum Oil)	5.0 (5 - 5) n1					
IRAC UN	AzaGuard (Azadirachtin)	1.7 (1 - 3) n3					1.0 (1 - 1) n1
IRAC UNE	TetraCURB Concentrate (Rosemary Oil)	1.0 (1 - 1) n1					2.0 (2 - 2) n1
IRAC UNE	TetraCURB Organic (Rosemary Oil)	1.0 (1 - 1) n1					1.0 (1 - 1) n1
unknown	KOC22018-8 (Botanical Oil Blend)	3.0 (3 - 3) n1					2.0 (2 - 2) n1

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MOA	Product (Active Ingredients)	Indian Wax Scale ( <i>Ceroplastes ceriferus</i> )	Lobate Lac Scale ( <i>Paratachardina pseudolobata</i> )	Magnolia Scale ( <i>Neolecanium cornuparvum</i> )	Pine Needle Scale ( <i>Phenacaspis pinifoliae</i> )	Scale, Calico ( <i>Eulecanium cerasorum</i> )	Scale, Cycad ( <i>Aulacaspis yasumatsui</i> )
IRAC 1B	Cygon 2E (Dimethoate)	1.0 (1 - 1) n1 Labeled					
IRAC 4A	Arena 50WDG (Clothianadin)					3.0 (3 - 3) n1	
	Flagship 0.22G (Thiamethoxam)			5.0 (5 - 5) n1	1.0 (1 - 1) n3		
	Flagship 25WG (Thiamethoxam)				2.0 (1 - 3) n2 Labeled		
	Marathon II (Imidacloprid)		5.0 (5 - 5) n1 Labeled				





MOA	Product (Active Ingredients)	Indian Wax Scale ( <i>Ceroplastes ceriferus</i> )	Lobate Lac Scale ( <i>Paratachardina pseudolobata</i> )	Magnolia Scale ( <i>Neolecanium cornuparvum</i> )	Pine Needle Scale ( <i>Phenacaspis pinifoliae</i> )	Scale, Calico ( <i>Eulecanium cerasorum</i> )	Scale, Cycad ( <i>Aulacaspis yasumatsui</i> )
unknown	RTSA 721 (RTSA 721)			3.0 (3 - 3) n2			

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MOA	Product (Active Ingredients)	Scale, Elongate Hemlock ( <i>Fiorinia externa</i> )	Scale, Holly Pit ( <i>Asterolecanium puteanum</i> )	Scale, Oystershell ( <i>Diaspidiotus ostreiformis</i> )	Scale, Tea ( <i>Fiorinia theae</i> )	Wax Myrtle Scale ( <i>Melanaspis deklei</i> )	Winged Euonymus Scale ( <i>Lepidosaphes yanagicola</i> )
IRAC 1B	Cygon 2E (Dimethoate)	3.0 (3 - 3) n2 Labeled					
	Orthene TTO 97 (Valent) (Acephate)		1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n2 Labeled			
IRAC 3A	Onyx (Bifenthrin)	2.0 (2 - 2) n1 Labeled					
IRAC 4A	Flagship 25WG (Thiamethoxam)	4.0 (4 - 4) n1 Labeled	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n2 Labeled			3.0 (3 - 3) n2 Labeled
	Marathon II (Imidacloprid)						
	Safari 20SG (Dinotefuran)	3.8 (2 - 5) n4 Labeled	1.0 (1 - 1) n1 Labeled	2.8 (1 - 5) n5 Labeled	4.5 (3 - 5) n4 Labeled	3.0 (3 - 3) n2 Labeled	1.0 (1 - 1) n3 Labeled
	Safari 2G (Dinotefuran)		1.0 (1 - 1) n1 Labeled		3.0 (1 - 5) n3 Labeled		
	TriStar 30SG (Acetamiprid)		1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n1 Labeled			
	TriStar 70WSP (Acetamiprid)	4.0 (4 - 4) n1 Labeled		2.0 (1 - 3) n2 Labeled			2.5 (2 - 3) n2 Labeled
IRAC 4A + IRAC 3	Aloft SC (Clothianadin + bifenthrin)		1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n1 Labeled			
IRAC 4D	Altus (Flupyradifurone)				3.0 (1 - 5) n2 Labeled		
IRAC 5 + IRAC 4C	Xxpire 40WG (Spinetoram + sulfoxafloz)				5.0 (5 - 5) n2 Labeled	2.0 (2 - 2) n1 Labeled	
IRAC 7C	Distance (Pyriproxyfen)		1.0 (1 - 1) n1 Labeled		3.0 (1 - 5) n5 Labeled	2.0 (1 - 3) n2 Labeled	2.0 (2 - 2) n1 Labeled
IRAC 7C + IRAC 4A	Tank Mix: Distance + TriStar (Pyriproxifen + acetamiprid)				3.3 (1 - 5) n4		

MOA	Product (Active Ingredients)	Scale, Elongate Hemlock ( <i>Fiorinia externa</i> )	Scale, Holly Pit ( <i>Asterolecanium puteanum</i> )	Scale, Oystershell ( <i>Diaspidiotus ostreiformis</i> )	Scale, Tea ( <i>Fiorinia theae</i> )	Wax Myrtle Scale ( <i>Melanaspis deklei</i> )	Winged Euonymus Scale ( <i>Lepidosaphes yanagicola</i> )
IRAC 9B	Rycar (Pyrifluquinazon)		1.0 (1 - 1) n1				
IRAC 9D	Ventigra Insecticide (Afidopyropen)				2.7 (1 - 4) n3 Labeled		
IRAC 16	Talus 40SC (Buprofezin)	4.0 (4 - 4) n1 Labeled	1.0 (1 - 1) n1 Labeled	5.0 (5 - 5) n2 Labeled	4.0 (4 - 4) n1 Labeled	3.0 (3 - 3) n2 Labeled	5.0 (5 - 5) n2 Labeled
IRAC 16	Talus 70DF (Buprofezin)				3.5 (2 - 5) n6 Labeled		
IRAC 23	Judo 25C (Spiromesifen)	1.0 (1 - 1) n1					
	Kontos (BYI 8330 240SC) (Spirotetramat)				5.0 (5 - 5) n1 Labeled		2.0 (2 - 2) n1 Labeled
IRAC 28	Mainspring GNL 200SC (Cyantraniliprole)				3.0 (1 - 5) n6		
	Sarisa 50SL (Cyclaniliprole)				3.3 (1 - 5) n3		
FRAC NC	MOI 201 (MOI 201)			1.0 (1 - 1) n1			
FRAC NC	Paraffin Oil (Paraffin Oil)					3.0 (3 - 3) n1	
FRAC NC	Saf-T-Oil (Horticultural Oil)				3.0 (3 - 3) n1		
FRAC NC	SuffOil X (Synergy) (Petroleum Oil)				4.0 (3 - 5) n2		
FRAC NC	Sun Spray Ultra-Fine Spray Oil (Paraffinic oil)					3.0 (3 - 3) n1	
FRAC NC	Ultra Pure Oil (BASF) (Petroleum Oil)				4.0 (4 - 4) n1		
IRAC UN	AzaGuard (Azadirachtin)				3.0 (3 - 3) n1		
IRAC UN	Triact (Clarified hydrophobic extract of neem oil)				1.0 (1 - 1) n1 Labeled		
IRAC UNF	Botanigard 22WP (Beauveria bassiana GHA)	1.0 (1 - 1) n1					

IRAC Class	Foliar Applied Insecticides (active ingredients)	Registered Use Site(s)	Knock Down	Residual Control (days)	REI	Scale Efficacy				Life Stages		
						Armored Scales	Cushion Scales	Felt Scales	Soft Scales	Immatures	Pupae	Adults
<b>Registered Products</b>												
1B	Cygon, Dimethoate (dimethoate)	N	F	5-7	48 h	G-E	-	-	-	x	-	x
	Duraguard, Dursban (chlorpyrifos)	G, N	F	5-7	24 h	F	-	-	P-G	x	-	x
	Malathion	G, N	F	5-7	12 h	E	-	-	-	x	-	x
	Orthene T&O, Acephate 97 UP, Precision (acephate)	G, N	F	7	24 h	P-E	F-G	-	P-G	x	-	x
	Supracide (methidathion)	N	F	?	48 h	-	-	-	E	x	-	x
3A	Astro, Permethrin.Pro, etc. (permethrin)	G, I	F	5-7	12 h	-	-	-	-	x	-	x
	Decathlon (cyfluthrin)	G, I, N	F	7	12 h	-	-	-	P	x	-	x
	Mavrik (fluvalinate)	G, I, N	F	14	12 h	-	-	-	-	x	-	x
	Scimitar GC (lambda-cyhalothrin)	G, N, S	F	7	24 h	-	-	-	-	x	-	x
	Talstar, Onyx (bifenthrin)	G, I, N	F	7	12 h	P-E	-	-	P	x	-	x
	Tame (fenpropathrin)	G, I, L, N, S	F	7	24 h	-	-	-	-	x	-	x
3A + -	Prentox Pyronyl Crop Spray, Pyrenone Crop Spray, etc. (pyrethrins + PBO)	G, N	F	Contact	12 h	-	-	-	-	x	-	x
3A + 4A	Discus (cyfluthrin+imidacloprid)	N	F	5-7	12 h	E	-	-	G	x	-	x
4A	Flagship 25WG (thiamethoxam)	G, I, L, N, S	F	7-14	12 h	P-E	P-G	-	F-E	x	-	x
	TriStar (acetamiprid)	G, L, N, S	F	-	12 h	P-E	G-E	-	P-E	x	?	x
	Marathon, Merit (imidacloprid)	G, I, N	F	-	12 h	G	-	G-E <sup>c</sup>	P	x	-	x
	Safari 20SG (dinotefuran)	G, N	M	7	12 h	P-E	P	E <sup>c</sup>	P-E	x	-	x
4D	Altus, BYI-2960 (flupyradifurone)	G, I, L, N, S	-	-	4 h <sup>a</sup>	P-E	-	E <sup>c</sup>	-	-	-	
5	Conserve SC, Entrust (spinosad)	G, L, N, S	F	5	4 h	-	-	-	-	x	-	x
5+4C	XXpire (spinetoram+ sulfoxaflor)	G, N	F	14	12 h	F-E	P-E	G-E	P-G	x	-	-
7A	Enstar AQ (kinoprene)	G, I, L, S	S	-	4 h	-	-	-	-	x	-	x
7D	Distance (pyriproxyfen)	G, I, L, S	S	-	12 h	P-E	P-E	-	P-F	x	-	-
9B	Rycar, NNI-0101 (pyrifluquinazon)	G	-	10	12 h	P-E	E	-	-	x	-	x
9D	Ventiga, BAS 440 (afidopyropen)	G, I, L, N, S	-	7	12 h	P-E	-	-	-	x	-	x
16	Talus (buprofezin)	G, L, N, S	S	14	12 h	P-E	P-E	E	P-G	x	-	x
18B	Aza-Direct, Molt-X, etc. (azadirachtin)	G, I, N, S	S	7	4 h	P-G	-	-	-	x	-	-
21A	Hachi-Hachi EC (tolfenpyrad)	G	F	7-14	12 h	-	-	-	-	x	-	x
23	Judo (spiromesifen)	G, N, S	M	7	12 h	-	-	-	-	x	-	x
	Kontos, BYI-8330 (spirotetramat)	G, I, N	S	7-14	24 h	P-E	P-E	-	E	x	-	x
28	Mainspring, A20520A, DPX-HGW86 (cyantraniliprole)	G, I	F	?	4 h	P-E	-	-	E	-	-	-
	Sarisa, IKI-3106 (cyclaniliprole)	G, N, S	-	7	4 h	P-G	-	-	P	-	-	-
28 + 29	Pradia (cyclaniliprole+flonicamid)	G, N, S	-	7	12 h	P	-	-	G	-	-	-
29	Aria (flonicamid)	G, I, N	M	7-14	12 h	-	-	-	-	x	-	x
UNB	Venerate, MBI-206 ( <i>Burkholderia</i> sp. strain A396)	G, N	S	3-10	4h	-	-	-	-	x	-	x
UNE	Ecotec, Ecotrol (rosemary and peppermint oils)	G, N	-	-	-	-	-	-	-	x	-	x

IRAC Class	Foliar Applied Insecticides (active ingredients)	Registered Use Site(s)	Knock Down	Residual Control (days)	REI	Scale Efficacy				Life Stages		
						Armored Scales	Cushion Scales	Felt Scales	Soft Scales	Immatures	Pupae	Adults
UNE	M-Pede, Safer Soap (potassium salts of fatty acids)	G, I, N	F	Contact	12 h	P	-	-	-	x	-	?
	TetraCURB Org (rosemary oil)	TBD	-	-	-	P	-	-	-	-	-	-
	Triact, Trilogy Neem Oil (extract of neem oil)	G, N	S	7	4 h	G	-	-	-	x	-	-
UNF	BotaniGard, Mycotrol, ( <i>Beauveria bassiana</i> strain GHA)	G, I, N, S	M	3	4 h	P-G	-	-	-	x	x	x
	NoFly WP ( <i>Paecilomyces fumosoroseus</i> strain FE 9901)	G	M	3-7	4 h	P - G	P - G	-	P - G	x	-	x
	Preferal, PFR-97 ( <i>Isaria fumosoroseus</i> )	G, L, N, S	S	Contact	4 h	-	-	-	-	x	-	x
	Met 52, Tick Ex ( <i>Metarhizium anisopliae</i> F52)	G, N	M	5-7	4 h	-	E	-	-	x	-	x
UNF + 3A	BotaniGard MAXX ( <i>Beauveria bassiana</i> + pyrethrins)	G, I, N, S	F	-	12 h	-	-	-	-	x	x	x
UNM	Surround WP (kaolin)	G	-	Contact	4 h	-	-	-	-	x	-	x
-	Ultra pure oil, SuffOil-X, etc. (paraffinic oil)	G, N	F	Contact	4 h	P-E	P-E	-	P-E	x	x	x
-	Grandevo, MBI-203 DF ( <i>Chromobacterium subtsugae</i> strain PRAA4-1 <sup>T</sup> )	G, N	S	-	4 h	G	-	-	-	x	-	x
-	Sorbishield 90 (sorbitol octanoate)	G, N	-	Contact	24 h	-	-	-	-	x	-	x
-	Sucrashield (sucrose octanoate)	G, N	-	Contact	48 h	-	-	-	-	x	-	x
Experimental Products												
3A + 4A	Aloft (bifenthrin + clothianidin)	TBD	F	-	12 h	P-G	-	-	-	x	-	x
4A	Arena, Celero 16WG (clothianidin)	TBD	-	-	12 h	P-E	P	-	F-E	x	-	x
4C	Transform, GF-2626 1SC (sulfoxaflor)	TBD	-	-	24 h	F-E	P-G	-	-	x	-	x
28 + 4A	A16901B (cyantraniliprole + thiamethoxam)	TBD	F	-	-	E	P	-	P	x	-	x
NC	Milstop <sup>b</sup> (potassium bicarbonate)	G, I, L, N, S	-	-	1 h	-	-	-	-	x	-	-
-	BW133 (BW133)	TBD	-	-	-	-	-	P	-	-	-	-
-	BW238 (BW238 ES)	TBD	-	-	-	-	-	P	-	-	-	-
-	BW238 (BW238 WP)	TBD	-	-	-	-	-	P	-	-	-	-
-	Facin ( <i>Chenopodium ambrosioides</i> )	TBD	-	-	-	-	-	-	-	x	-	x
-	ISM-555(ISM-555, A21377X)	TBD	-	-	-	-	-	E	-	-	-	-
-	KOC22018-8 (botanical oil blend)	TBD	-	-	-	P	-	-	-	-	-	-
-	MBI 203 SC2 (MBI 203)	TBD	-	-	-	-	-	P	-	-	-	-
-	MBI 306(MBI 306)	TBD	-	-	-	-	-	P	-	-	-	-
-	RTSA 721 (RTSA 721)	TBD	-	-	-	-	-	-	G	-	-	-
-	SP 3014 (SP 3014)	TBD	-	-	-	-	-	P	-	-	-	-
-	QRD 416 (oil extract from <i>Chenopodium sp.</i> ) <sup>b</sup>	TBD	-	-	-	-	-	-	-	x	-	x
-	V-10433 (V-10433)	TBD	-	-	-	-	-	P	-	-	-	-

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.



## Registered and Experimental Products for Scale Management

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Residual Control taken from product technical and label info, recommendations on earliest application intervals; Scale Efficacy taken from the 2017 IR-4 efficacy summary, 5 IR-4 reports and 7 AMT reports. Effect on biological control agents for scales/mealybugs taken from Koppert, Biobest and some extension publications/recommendations.

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

Cushion scales: *Icerya purchasi*,

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

\* 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.

<sup>a</sup> 12 h in California

<sup>c</sup> Drench application

<sup>d</sup> RTSA 721 applied basal spray or drench.

Updated 9/20/21