

**IR-4 Ornamental Horticulture Program
Scale and Mealybug Efficacy**

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Abstract

Four insecticides - Flagship 25WP, Safari 20SG, Talus 40SC and TriStar 30SG – were tested against scales and mealybugs. All products provided excellent control of elongate hemlock scale and cryptomeria scale, and generally mediocre to good control of Fletcher scale. Control of Florida wax scale was excellent with Flagship and TriStar, but poor with Talus. Conversely, Talus was the only foliar product providing excellent control of oystershell scale; Safari applied as drench also provided excellent control. Cottony maple scale control was mediocre to good with Flagship, none to mediocre with Safari, poor with Talus and none to mediocre with TriStar. Control of cottony cushion scale was good with TriStar and poor with Safari. Euonymus scale control was good with Talus, mediocre to good with Flagship, mediocre with TriStar and poor with Safari.

Safari, Talus and TriStar were tested on citrus, Madeira and Mexican mealybugs; Flagship and Aria 50SG were tested on citrus and Mexican mealybugs. All products 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.

Introduction

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. This research was conducted during 2004 and continued in 2005.

Materials and Methods

Four insecticides - Flagship 25WP, Safari 20SG, Talus 40SC and TriStar 30SG – were tested against scales and mealybugs. A fifth insecticide Aria 50SG was tested against mealybugs only. Two foliar applications of Flagship 25WP, Safari 20SG, Talus 40SC and TriStar 30SG and Aria 50SG were made approximately 14 days apart. Also one container drench or in-ground drench application of Safari was made. A minimum of four plants (replicate treatments) were required with most researchers exceeding this minimum. Insect counts were recorded pre-treatment and then 7, 14 (prior to 2nd application), 28 and 42 days after initial application. Phytotoxicity was recorded on a scale of 0 to 10 (0 = No phytotoxicity; 10 = Complete kill) at each rating date. For more detailed materials and methods, including application rates for various products, please see Appendix 1: Protocols.

Products were supplied to researchers (See list of researchers in Appendix 2) by Bayer, Cleary, FMC, OHP, SePro, Syngenta, and Valent.

Results and Summary

Comparative Efficacy on Soft Scale

Cottony Maple Scale. In this trial, no statistical differences were observed among the treatments applied to manage cottony maple scale (*Pulvinaria innumerabilis*) on silver maple (*Acer saccharinum*). The untreated populations declined rapidly confounding the results. However, at 28 DAT there appeared to be good control achieved with foliar applications of Flagship 25 WP (2 and 4 oz per 100 gallons) and Safari 20SG (4 oz per 100 gallons). More research is needed to clarify response of cottony maple scale with these treatments. Please see trial report in Appendix 3 for additional information.

Fletcher Scale. In 2004, Smitley and Davis conducted a trial examining efficacy on Fletcher scale (*Lecanium fletcheri*) on yew (*Taxus sp.*). These researchers added a number of treatments above and beyond the 2004 IR-4 protocol for scale efficacy. The best efficacy was achieved with foliar applications of Discus with OSS and TriStar at 128 grams per 100 gal.

Table 1. Efficacy on Cottony Maple Scale on Silver Maple, Smitley & Davis, MI, 2005.

Treatment	Rate per 100 gal (No. Applications)	Pretreatment Counts	28 DAT	35 DAT	Combined 28 + 35 DAT
Flagship 25WP	2.0 oz (2)	45.0 a	0.2 a (96)	0.8 a (0)	1.0 a (82)
Flagship 25WP	4.0 oz (2)	37.0 a	0.8 a (81)	1.0 a (0)	1.8 a (61)
Safari 20SG	4.0 oz (2)	43.2 a	1.2 a (76)	1.6 a (0)	2.8 a (48)
Safari 20SG	8.0 oz (2)	63.8 a	3.4 a (54)	2.6 a (0)	6.0 a (25)
Safari 20SG – Drench	3 g (2)	39.2 a	6.6 a (0)	0.6 a (0)	7.2 a (0)
Safari 20SG – Drench	6 g (2)	37.2 a	1.4 a (67)	1.8 a (0)	3.2 a (31)
Talus 40SC	21.5 fl oz (2)	51.4 a	2.6 a (56)	0.8 a (0)	3.4 a (47)
TriStar 30SG	112 g (2)	35.8 a	5.0 a (0)	0.0 a (100)	5.0 a (0)
TriStar 30SG	224 g (2)	40.4 a	1.8 a (61)	0.2 a (49)	2.0 a (60)
Marathon II	1.7 fl oz (2)	61.2 a	4.2 a (41)	2.6 a (0)	6.8 a (11)
Talstar 0.67 F	10 fl oz (2)	55.2 a	2.0 a (69)	6.4 a (0)	8.4 a (0)
Untreated check	-	62.4 a	7.2 a (0)	0.6 a (0)	7.8 a (0)

* B-1956 surfactant mixed with Safari and TriStar foliar applications.

Table 2. Efficacy on Fletcher Scale on Yew, Smitley & Davis, MI, 2004.

Treatment	Rate	Application Type	Application Date(s)	Population Counts	Percent Control
Discus	1.91 gal/A	banded	6/18	3.00 ± 2.83 abcde	67
Discus & OSS	25 fl oz/100	foliar	6/29 & 7/14	1.17 ± 1.33 a	87
Distance 0.86E & OSS	8 oz/100 gal	foliar	6/29 & 7/20	8.17 ± 12.00 def	9
Distance 0.86E & OSS	16 oz/100 gal	foliar	6/29 & 7/14	3.33 ± 2.07 bcde	63
Distance 0.86E & OSS	32 oz/100 gal	foliar	6/29 & 7/20	4.50 ± 2.59 def	50
Dursban Pro & OSS	1 qt/100 gal	foliar	6/29 & 7/14	2.83 ± 2.32 abcde	69
Flagship 25 WP	0.125 lb ai/A	banded	6/15	1.67 ± 1.97 abc	81
Flagship 25WP & OSS	2 oz/100 gal	foliar	6/29 & 7/14	2.00 ± 1.55 abcd	78
Flagship 25WP & OSS	4 oz/100 gal	foliar	6/29 & 7/14	3.33 ± 1.97 bcde	63
Flagship 25WP & OSS	8 oz/100 gal	foliar	6/29 & 7/14	2.50 ± 0.84 abcde	72
Safari 20SG & OSS	8 oz/100 gal	foliar	6/29 & 7/14	3.50 ± 2.17 cde	61
Safari 20SG	12 oz/100 gal	banded	6/15	4.67 ± 1.75 ef	48
Safari 20SG	24 oz/100 gal	banded	6/15	2.00 ± 1.10 abcde	78
Safari 20SG	48 oz/100 gal	banded	6/15	3.17 ± 2.93 abcde	72
Talus 40SC & OSS	21.5 fl oz/100 gal	foliar	6/29	2.00 ± 1.79 abcd	78
Talus 40SC & OSS	43.0 fl oz/100 gal	foliar	6/29	2.33 ± 1.21 abcde	74
Talus 40SC & OSS	86.0 fl oz/100	foliar	6/29	3.17 ± 2.93 abcde	65
Talus 70WP & OSS	14 oz/100 gal	foliar	6/29	2.17 ± 1.47 abcde	76
Talus 70WP & OSS	28 oz/100 gal	foliar	6/29	3.83 ± 2.64 de	57
Talus 70WP & OSS	14 oz/100 gal **	foliar	6/29	4.83 ± 4.45 def	46
TriStar	32 grams/100 gal	foliar	6/29 & 7/14	3.50 ± 2.43 abcde	61
TriStar	64 grams/100 gal	foliar	6/29 & 7/14	2.00 ± 1.10 abcde	78
TriStar	128 grams/100 gal	foliar	6/29 & 7/14	1.17 ± 1.17 ab	87
Untreated Control				9.00 ± 3.63 f	0

* All data were transformed log (1+x) before statistical analysis. Means followed by the same letter are not significantly different (p<0.05). Untransformed means are presented in the table. See trial report in Appendix 3 for additional information on statistical separation.

** This treatment was supposed to have been 56 oz/100 gal

Florida Wax Scale. In 2005, Ludwig conducted three Florida wax scale () efficacy trials on dwarf buford holly (*Ilex cornuta* 'Burfordii Nana'), holly 'China Doll' (*Ilex sp.*), and Indian hawthorn (*Rhaphiolepis indica*).

Table 3. Efficacy on Florida Wax Scale on Dwarf Buford Holly, Ludwig, TX, 2004.

Treatment (Rate)	Population Averages (Henderson's Percent Control)				
	0 DAT (Visual)	16 DAT (Visual)	30 DAT (Visual)	43 DAT (Visual)	45 DAT (Microscope)
Talus 40SC (21.5 fl oz)	105.0	152.5 (2)	121.5 (13)	94.0 (20)	13.8 bc (82)
Talus 40SC (43 fl oz)	110.8	143.0 (12)	114.3 (23)	96.5 (22)	13.0 bc (84)
Talus 40SC (86 fl oz)	185.8	203.5 (26)	200.0 (19)	160.3 (23)	17.5 bc (87)
Safari (12 oz / 100 gal) - Drench	117.0	181.3 (0)	164.8 (0)	119.0 (9)	6.0 cd (93)
Safari (24 oz / 100 gal) - Drench	129.5	137.8 (28)	125.8 (27)	96.3 (33)	1.0 d (99)
Safari (48 oz / 100 gal) - Drench	104.5	131.3 (15)	110.3 (21)	38.5 (67)	0.0 d (100)
Distance (8 oz / 100 gal)	124.8	164.3 (11)	142.5 (14)	118.5 (15)	23.8 bc (73)
Distance (16 oz / 100 gal)	113.8	173.0 (0)	149.8 (1)	101.5 (20)	19.8 bc (76)
Distance (32 oz / 100 gal)	143.0	173.0 (18)	199.8 (0)	174.3 (0)	14.0 bc (86)
Flagship (2 oz / 100 gal)	128.5	162.5 (14)	89.3 (48)	65.5 (54)	0.3 d (100)
Flagship (4 oz / 100 gal)	129.3	146.0 (23)	93.8 (46)	70.5 (51)	0.0 d (100)
Flagship (8 oz / 100 gal)	128.3	181.8 (4)	73.3 (57)	47.5 (67)	0.0 d (100)
TriStar 70WSP (32 g / 100 gal)	125.5	112.5 (39)	54.8 (67)	40.5 (71)	0.0 d (100)
TriStar 70WSP (64 g / 100 gal)	142.8	179.3 (15)	88.5 (54)	79.8 (50)	0.0 d (100)
TriStar 70WSP (128 g / 100 gal)	107.3	125.0 (21)	59.3 (59)	42.5 (64)	0.0 d (100)
Untreated	132.5	195.5 (0)	177.0 (0)	147.5 (0)	94.8 a (0)

* Letters after numbers are based on separation of average number of scale on the same 20 leaves throughout the experiment. See trial report in Appendix 3 for statistical separation details.

Table 4. Efficacy on Florida Wax Scale on Dwarf Buford Holly, Ludwig, TX, 2005.

Scale Stage	Treatment	Rate	Population Averages (Henderson's Percent Control)				
			Pre-treatment counts	14 DAT	28 DAT	42 DAT	56 DAT
Nymph	Flagship 25WG	2 oz	0.0	13.4 ab	8.2 ab	3.8 ab	0.0
	Flagship 25WG	4 oz	0.0	21.6 a	12.6 a	10.2 a	0.0
	TriStar 30SG	4 oz	0.0	10.4 ab	7.2 ab	6.0 b	0.0
	TriStar 30SG	8 oz	0.0	10.6 b	6.6 ab	4.6 ab	0.0
	Celero 16WSG	4 oz	0.0	11.8 ab	7.8 ab	7.2 ab	0.0
	Orthene TTO 97	8 oz	0.0	15.2 ab	7.0 ab	4.2 ab	0.0
	Untreated		0.0	8.6 ab	4.2 b	3.6 b	0.0
Adults	Flagship 25WG	2 oz	21.0 ab	57.8 ab (49)	92.2 a (8)	75.0 a (36)	2.4 b (98)
	Flagship 25WG	4 oz	24.6 a	51.6 ab (61)	74.4 ab (37)	72.2 a (47)	2.6 bc (98)
	TriStar 30SG	4 oz	21.0 ab	47.0 ab (58)	41.0 bc (59)	39.0 ab (67)	0.2 d (100)
	TriStar 30SG	8 oz	20.0 ab	33.4 b (69)	34.8 c (64)	30.0 b (73)	0.4 cd (100)
	Celero 16WSG	4 oz	19.2 ab	39.4 ab (62)	49.8 abc (46)	50.2 ab (53)	1.2 bcd (99)
	Orthene TTO 97	8 oz	18.2 ab	61.2 a (38)	84.8 ab (3)	78.6 a (23)	34.0 a (60)
	Untreated		13.8 b	74.4 a (0)	66.0 ab (0)	77.0 a (0)	65.0 a (0)
Total	Flagship 25WG	2 oz	21.0	71.2 (44)	100.4 (6)	78.8 (36)	2.4 (98)
	Flagship 25WG	4 oz	24.6	73.2 (51)	87.0 (30)	82.4 (43)	2.6 (98)
	TriStar 30SG	4 oz	21.0	57.6 (54)	47.6 (55)	43.6 (64)	0.2 (100)
	TriStar 30SG	8 oz	20.0	43.8 (64)	42.0 (59)	36.0 (69)	0.4 (100)
	Celero 16WSG	4 oz	19.2	51.2 (56)	57.6 (41)	57.4 (49)	1.2 (99)
	Orthene TTO 97	8 oz	18.2	76.4 (30)	91.8 (1)	82.8 (22)	34.0 (60)
	Untreated		13.8	83.0 (0)	70.2 (0)	80.6 (0)	65.0 (0)

* Letters after numbers are based on separation of average number of scale on 5 plants. See trial report in Appendix 3 for statistical separation details.

Table 5. Efficacy on Florida Wax Scale on Holly ‘China Doll’, Ludwig, TX, 2005.

Scale Stage	Treatment	Rate	Population Averages (Henderson’s Percent Control)			
			Pretreatment counts (Visual)	14 DAT (Visual)	28 DAT (Visual)	45 DAT (Microscope)
Nymph	Flagship 25WG	2 oz	247.3 a	13.3 ab (59)	12.3 ab (77)	0.0
	Flagship 25WG	4 oz	121.8 bc	1.5 bcd (91)	6.0 abc (77)	0.0
	TriStar 30SG	4 oz	149.8 bc	1.5 abc (92)	0.5 bcd (98)	0.0
	TriStar 30SG	8 oz	120.0 bc	6.5 cd (59)	2.8 d (89)	0.0
	Celero 16WSG	4 oz	87.3 c	3.0 abcd (74)	4.0 abcd (79)	0.0
	Orthene TTO 97	8 oz	200.5 ab	0.0 d (100)	2.3 cd (95)	0.0
	Talus 40SC	21.5 fl oz	133.0 abc	9.5 ab (46)	13.0 a (55)	0.0
	Untreated		77.5 c	10.3 a (0)	16.8 a (0)	0.0
Adults	Flagship 25WG	2 oz	0.3	184.0 a (100)	80.8 a (100)	37.3 a (100)
	Flagship 25WG	4 oz	0.0	86.8 bc	48.5 abc	5.0 bc
	TriStar 30SG	4 oz	0.0	65.5 abc	21.3 abc	5.8 ab
	TriStar 30SG	8 oz	0.3	77.8 c (100)	44.5 d (100)	13.8 c (100)
	Celero 16WSG	4 oz	0.0	42.0 c	21.8 cd	11.8 ab
	Orthene TTO 97	8 oz	0.0	124.0 ab	57.5 ab	4.8 bc
	Talus 40SC	21.5 fl oz	0.8	87.5 bc (100)	49.8 bc (100)	29.3 a (100)
	Untreated		0.0	54.3 bc	30.5 bc	28.3 a
Total	Flagship 25WG	2 oz	247.5	197.3 (4)	93.0 (38)	37.3 (59)
	Flagship 25WG	4 oz	121.8	88.3 (13)	54.5 (27)	5.0 (89)
	TriStar 30SG	4 oz	120.0	72.0 (28)	24.0 (67)	5.8 (87)
	TriStar 30SG	8 oz	150.0	79.3 (37)	45.0 (51)	13.8 (75)
	Celero 16WSG	4 oz	87.3	45.0 (38)	25.8 (52)	11.8 (63)
	Orthene TTO 97	8 oz	200.5	124.0 (26)	59.8 (51)	4.8 (94)
	Talus 40SC	21.5 fl oz	133.8	97.0 (13)	62.8 (23)	29.3 (40)
	Untreated		77.5	64.5 (0)	47.3 (0)	28.3 (0)

* Letters after numbers are based on separation of average number of scale on 20 leaves on each of 5 plants. See trial report in Appendix 3 for statistical separation details and scale averages for each treatment.

Table 6. Efficacy on Florida Wax Scale on Indian Hawthorn, Ludwig, TX, 2005.

Scale Stage	Treatment	Rate	Population Averages (Henderson's Percent Control)				
			Pretreatment counts (Visual)	15 DAT (Visual)	28 DAT (Visual)	41 DAT (Visual)	57 DAT (Microscope)
Nymph	Celero 16WSG	4 oz	0.0	42.0 a	50.4 a	12.2 bc	14.0 b
	Flagship 25WG	2 oz	0.0	32.2 a	45.4 a	24.2 b	13.6 ab
	Flagship 25WG	4 oz	0.0	42.8 a	55.6 a	30.2 b	9.2 ab
	TriStar 30SG	4 oz	0.0	35.5 a	6.5 a	4.0 c	7.5 b
	TriStar 30SG	8 oz	0.0	25.2 a	7.8 a	1.8 c	5.4 b
	Untreated		0.0	42.0 a	64.2 a	140.2 a	32.0 a
Adults	Celero 16WSG	4 oz	41.4 a	--	--	--	27.8 b (90)
	Flagship 25WG	2 oz	51.0 a	--	--	--	22.0 b (94)
	Flagship 25WG	4 oz	48.6 a	--	--	--	13.8 b (96)
	TriStar 30SG	4 oz	46.8 a	--	--	--	6.5 b (98)
	TriStar 30SG	8 oz	32.6 a	--	--	--	6.2 b (97)
	Untreated		37.2 a	--	--	--	248.6 a (0)
Total	Celero 16WSG	4 oz	41.4	42.0 (10)	50.4 (29)	12.2 (92)	41.8 (87)
	Flagship 25WG	2 oz	51.0	32.2 (44)	45.4 (48)	24.2 (87)	35.6 (91)
	Flagship 25WG	4 oz	48.6	42.8 (22)	55.6 (34)	30.2 (84)	23.0 (94)
	TriStar 30SG	4 oz	46.8	35.5 (33)	6.5 (92)	4.0 (98)	14.0 (96)
	TriStar 30SG	8 oz	32.6	25.2 (32)	7.8 (86)	1.8 (99)	11.6 (95)
	Untreated		37.2	42.0 (0)	64.2 (0)	140.2 (0)	280.6 (0)

* Letters after numbers are based on separation of average number of scale on 20 leaves on each of 5 plants. See trial report in Appendix 3 for statistical separation details and scale averages for each treatment.

Comparative Efficacy on Armored Scale

Elongate Hemlock and Cryptomeria Scales. In a single trial for control of both elongate hemlock scale (*Fiorinia externa*) and Cryptomeria Scale (*Aspidiotus cryptomeriae*) on Fraser Fir (*Abies fraseri*), Flagship 25WP, Safari 20SG, Talus 40SC, and TriStar 70WSP provided excellent control at all tested rates. Cygon 267 and Onyx also performed well. Another product providing good efficacy was Esteem 35WP. Lesco Oil provided poor control except when paired with Silwet L-77.

Table 7. Efficacy on Elongate hemlock scale and cryptomeria scale on Fraser Fir, Cowles, CT, 2005.

Treatment	Rate (No. of applications)	Live per 1000 needles	Percent Control
Flagship 25WP	2.0 oz/100 gal (2)	273 c-f	97
Flagship 25WP	4.0 oz/100 gal (2)	240 b-f	97
Safari 20SG	4.0 oz/100 gal (2)	453 b-f	94
Safari 20SG	8.0 oz/100 gal (2)	49.1 fgh	99
Safari 20SG – Drench	3 g/ft of tree height	12.4 gh	100
Safari 20SG – Drench	6 g/ft of tree height	0.0 h	100
Talus 40SC	21.5 fl oz/100 gal (2)	348 b-f	96
TriStar 70WSP	48 g/100 gal (2)	225 def	97
TriStar 70WSP	96 g/100 gal (2)	554 fgh	93
Admire 2F - Drench	0.5 lb/Acre, drench	3080 ab	63
Esteem 35WP	2.5 oz/100 gal (2)	800 b-f	90
Lesco Oil	1%	3280 ab	60
Lesco Oil	2%	5270 a	36
Lesco Oil + Silwet L-77	2% + 4 fl oz/100 gal	2244 abc	73
Lorsban 75WDG	0.66 lb/100 gal (2)	1320 a-d	84
Cygon 267	32 fl oz/100 gal (2)	507 b-f	94
Cygon 267 - Drench	60 ml/tree, drench	313 efg	96
Onyx	2.6 oz/100 gal	452 b-e	94
Onyx + Lesco Oil	2.6 oz/100 gal + 1%	1160 a-d	86
Untreated check	-	8220 a	-

* Letters after numbers are based on separation of average number of scale on 4 plants. See trial report in Appendix 3 for statistical separation details.

Winged Euonymus Scale. Efficacy of several products and new active ingredients were tested in two trials conducted in 2004 and 2005 at the Rutgers Cream Ridge Station for winged Euonymus scale (*Lepidosaphes yanagicola*) on Euonymus. In the 2004 trial, treatments did not start exhibiting good efficacy until 27 DAT, but only Talus SC provided 100% control by 45 DAT. Most of the systemic products had delayed efficacy similar to the growth regulators Talus and Distance. BYI 8330 provided some efficacy in this trial. In the 2005 trial, none of the products performed better than 87% control with only Orthene and Flagship providing reasonable control throughout the trial. Talus did achieve the same level by the end of the experiment. Safari 20SG did not reduce mealybug populations either as a drench or foliar application.

Table 8. Efficacy on Winged Euonymus Scale on Euonymus, Freiberger, NJ, 2004.

Treatment	Rate	Population Averages (Henderson's Percent Control)				
		Pretreatment counts (6/28/04 & 6/30/04)	6 DAT	13 DAT	27 DAT	45 DAT
BYI 8330 *	20 fl oz/100 gal	18.7	26.9 (33)	7.8 (73)	6.3 (87)	58.8 (71)
BYI 8330 *	40 fl oz/100 gal	7.3	10.8 (32)	7.1 (37)	9.6 (49)	97.0 (0)
Diazinon	8.96 oz/100 gal	7.2	13.4 (13)	7.9 (28)	5.3 (71)	48.8 (38)
Distance 0.86E	8 oz/100 gal	14.5	30.4 (3)	22.9 (0)	20.6 (44)	72.1 (55)
Distance 0.86E	16 oz/100 gal	3.4	19.2 (0)	11.8 (0)	6.4 (26)	26.3 (30)
Distance 0.86E	32 oz/100 gal	12.5	32.1 (0)	14.9 (22)	7.2 (77)	19.4 (86)
Flagship 25 WG	2 oz/100 gal	9.7	15.4 (26)	11.1 (25)	11.5 (53)	113.1 (0)
Flagship 25 WG	4 oz/100 gal	32.4	30.6 (56)	13.3 (73)	14.7 (82)	80.0 (77)
Flagship 25 WG	8 oz/100 gal	31.9	47.3 (31)	23.1 (53)	22.8 (72)	105.0 (70)
Safari 20SG **	12 oz/100 gal	9.8	23.5 (0)	21.6 (0)	35.0 (0)	228.6 (0)
Safari 20SG **	24 oz/100 gal	3.4	11.5 (0)	17.2 (0)	20.8 (0)	80.5 (0)
Safari 20SG **	48 oz/100 gal	6.2	10.6 (20)	13.6 (0)	15.5 (1)	101.4 (0)
Talus 40 SC	21.5 fl oz/100 gal	8.8	20.2 (0)	20.4 (0)	12.4 (45)	25.9 (73)
Talus 40 SC	43 fl oz/100 gal	9.0	23.5 (0)	9.3 (33)	7.0 (69)	0.0 (100)
Talus 40 SC	86 fl oz/100 gal	15.4	29.3 (12)	10.7 (55)	5.6 (86)	0.7 (100)
TriStar 70WSP	32 g/100 gal	8.6	26.1 (0)	6.3 (53)	6.9 (68)	33.2 (65)
TriStar 70WSP	64 g/100 gal	9.8	17.0 (19)	12.0 (20)	12.7 (49)	18.3 (83)
TriStar 70WSP	128 g/100 gal	33.0	50.5 (29)	21.5 (58)	20.8 (75)	87.3 (76)
Untreated Control	---	13.7	29.6 (0)	21.1 (0)	34.8 (0)	150.5 (0)

* BYI 8330 was applied solely on 7/2/04

** Safari SG was applied as foliar spray instead of drench

Table 9. Efficacy on Euonymus Scale on Euonymus, Freiberger, NJ, 2005.

Treatment	Rate	Population Averages (Henderson's Percent Control)				
		Pretreatment Counts	7 DAT	15 DAT	29 DAT	44 DAT
Flagship	2 oz per 100 gal	21.2	25.9 (55)	36.7 (36)	20.7 (63)	22.6 (66)
Flagship	4 oz per 100 gal	25.4	16.6 (76)	22.8 (67)	9.1 (87)	15.6 (81)
Orthene TTO	8 oz per 100 gal	24.0	12.1 (81)	21.9 (66)	20.1 (69)	10.7 (86)
Safari drench	12 oz/acre	3.9	8.1 (24)	10.9 (0)	10.9 (0)	24.0 (0)
Safari drench	24 oz/acre	5.1	16.2 (0)	22.3 (0)	22.7 (0)	41.8 (0)
Safari foliar	4 oz per 100 gal	11.4	20.7 (32)	39.7 (0)	39.0 (0)	57.9 (0)
Safari foliar	8 oz per 100 gal	11.8	14.0 (56)	20.3 (36)	16.2 (48)	28.7 (23)
Talus 40SC	21.5 fl oz per 100 gal	5.3	13.8 (4)	8.6 (40)	2.1 (85)	4.7 (72)
TriStar 70WSP	112 g per 100 gal	20.3	24.1 (56)	30.6 (44)	33.8 (37)	29.5 (54)
TriStar 70WSP	224 g per 100 gal	16.1	14.7 (66)	41.5 (4)	59.8 (0)	42.3 (17)
Untreated Control	---	16.2	43.6 (0)	43.5 (0)	43.1 (0)	51.0 (0)

* Note: outlier data point in Flagship 4 oz per 100 gallon rate was removed. This bush started with 348 scale in the initial count, an amount far greater than any other plant.

Florida Red Scale. Ludwig investigated whether four neonicotinoids (Celero, Flagship, Safari and TriStar) have activity on Florida Red Scale (*Chrysomphalus aonidum*) infesting Dwarf Buford Holly (*Ilex cornuta* 'Burfordii Nana'). During the course of this research, the average daily temperatures decreased which may have contributed to the increased mortality observed in all the treatments throughout the experiment. None of the treatments provided statistically or biologically significant mortality on this scale species at 32 or 43 days after treatment. Only the standard, Orthene provided statistically significant mortality for both small and large nymphs, but only 72% and 32% mortality was achieved respectively. More research is needed to determine viable product choices for Florida Red Scale.

Table 10. Efficacy on Florida Red Scale on Dwarf Buford Holly, Ludwig, TX, 2005.

Stage	Treatment	Rate	Population Averages (Henderson's Percent Control)			
			Pretreatment Counts	7 DAT	15 DAT	29 DAT
Small Nymphs	Celero 16WSG	4 oz per 100 gal	50.0	39.2 cd (0)	27.2 a (0)	60.3 ab (0)
	Flagship	2 oz per 100 gal	50.0	69.6 a (0)	27.2 a (0)	56.3 ab (0)
	Flagship	4 oz per 100 gal	50.0	59.2 ab (0)	12.8 a (0)	81.9 a (0)
	Orthene TTO	8 oz per 100 gal	50.0	72.0 a (0)	37.6 a (0)	57.6 ab (0)
	Safari drench	12 oz/acre	50.0	61.6 ab (0)	24.8 a (0)	58.8 ab (0)
	Safari drench	24 oz/acre	50.0	44.0 bcd (0)	20.0 a (0)	60.7 ab (0)
	Safari foliar	4 oz per 100 gal	50.0	60.8 ab (0)	16.0 a (0)	71.8 ab (0)
	Safari foliar	8 oz per 100 gal	50.0	47.2 bcd (0)	14.4 a (0)	72.9 ab (0)
	TriStar 30SG	112 g per 100 gal	50.0	44.0 bcd (0)	35.2 a (0)	61.8 ab (0)
	TriStar 30SG	224 g per 100 gal	50.0	56.0 abc (0)	23.2 a (0)	54.7 ab (0)
	Untreated Control	---	50.0	31.2 d (0)	8.8 a (0)	49.5 b (0)
Large Nymphs	Celero 16WSG	4 oz per 100 gal	0.0	4.0 c	36.0 a	53.7 a
	Flagship	2 oz per 100 gal	0.0	6.4 bc	18.4 ab	43.2 a
	Flagship	4 oz per 100 gal	0.0	13.6 bc	11.2 b	55.1 a
	Orthene TTO	8 oz per 100 gal	0.0	32.0 a	18.4 ab	64.0 a
	Safari drench	12 oz/acre	0.0	9.6 bc	25.6 ab	56.5 a
	Safari drench	24 oz/acre	0.0	20.0 ab	19.2 ab	67.7 a
	Safari foliar	4 oz per 100 gal	0.0	12.0 bc	12.0 b	56.1 a
	Safari foliar	8 oz per 100 gal	0.0	7.2 bc	14.4 ab	62.4 a
	TriStar 30SG	112 g per 100 gal	0.0	7.2 bc	18.4 ab	57.5 a
	TriStar 30SG	224 g per 100 gal	0.0	9.6 bc	25.6 ab	55.0 a
	Untreated Control	---	0.0	7.2 bc	11.2 b	47.3 a
Total	Celero 16WSG	4 oz per 100 gal	50.0	43.2 (0)	63.2 (0)	114.0 (0)
	Flagship	2 oz per 100 gal	50.0	76.0 (0)	45.6 (0)	99.6 (0)
	Flagship	4 oz per 100 gal	50.0	72.8 (0)	24.0 (0)	137.0 (0)
	Orthene TTO	8 oz per 100 gal	50.0	104.0 (0)	56.0 (0)	121.6 (0)
	Safari drench	12 oz/acre	50.0	71.2 (0)	50.4 (0)	115.4 (0)
	Safari drench	24 oz/acre	50.0	64.0 (0)	39.2 (0)	128.4 (0)
	Safari foliar	4 oz per 100 gal	50.0	72.8 (0)	28.0 (0)	127.9 (0)
	Safari foliar	8 oz per 100 gal	50.0	54.4 (0)	28.8 (0)	135.2 (0)
	TriStar 30SG	112 g per 100 gal	50.0	51.2 (0)	53.6 (0)	119.3 (0)
	TriStar 30SG	224 g per 100 gal	50.0	65.6 (0)	48.8 (0)	109.8 (0)
	Untreated Control	---	50.0	38.4 (0)	20.0 (0)	96.8 (0)

Oystershell Scale. In two trials on Oystershell scale, Nielsen (Tables 10 & 11) demonstrated that drench applications of Safari 20SG and foliar applications of Talus 40SC provided great control of this pest on Tree Lilac (*Syringa sp.*) and Carolina silverbell (*Halesia carolina* var. *Carolina*). TriStar 70WSP also provided good control when applied foliarly to Carolina silverbell. The other products tested, Flagship 25WP, foliar Safair 20SG, and Orthene TTO 97 provided little to no control.

Table 11. Efficacy on Oystershell Scale on Tree Lilac ‘Sensation’, Nielsen, OH, 2005.

Treatment	Rate (Number of applications)	No. Live Females in a 5 min Search*	Percent Control
Flagship 25WP	2.0 oz/100 gal (2)	4	27
Flagship 25WP	4.0 oz/100 gal (2)	7	0
Safari 20SG	4.0 oz/100 gal (2)	7	0
Safari 20SG	8.0 oz/100 gal (2)	5	9
Safari 20SG – Drench	3 g/ft of tree height	0.67	88
Safari 20SG – Drench	6 g/ft of tree height	0.25	95
Talus 40SC	21.5 fl oz/100 gal (2)	0.25	95
TriStar 70WSP	48 g/100 gal (2)	4.3	22
TriStar 70WSP	96 g/100 gal (2)	7.5	0
Orthene 97	8.0 oz/100 gal (2)	3	45
Untreated check	-	5.5	-

* Two evaluators, so this equates to a 10 minute search/sample.

Table 12. Efficacy on Oystershell Scale on Carolina Silverbell, Nielsen, OH, 2005.

Treatment	Rate (Number of applications)	No. Females with Eggs/m	Percent Control
Flagship 25WP	2.0 oz/100 gal (2)	11	21
Flagship 25WP	4.0 oz/100 gal (2)	8	43
Safari 20SG	4.0 oz/100 gal (2)	23	0
Safari 20SG	8.0 oz/100 gal (2)	55	0
Safari 20SG – Drench	3 g/ft of tree height	0	100
Safari 20SG – Drench	6 g/ft of tree height	0	100
Talus 40SC	21.5 fl oz/100 gal (2)	0	100
TriStar 70WSP	48 g/100 gal (2)	20	0
TriStar 70WSP	96 g/100 gal (2)	2*	86
Orthene 97	8.0 oz/100 gal (2)	10	26
Untreated check	-	14	-

* Many dead nymphs.

Comparative Efficacy on Cushion Scale

Cushion scale species are not as common as the other scale species tested in this program. They are a unique group and, unlike other scale species, adults are able to move around.

Cottony Cushion Scale. In a single test of Safari, TriStar, Celero and Orthene for control of cottony cushion scale (*Icerya purchasi*) on cleyera (*Ternstroemeria sp.*), no statistically significant differences were observed until 21 DAT (Table 1). At this date, TriStar and Orthene provided good control.

Table 13. Efficacy on Cottony Cushion Scale on Cleyera, Ludwig, TX, 2005.

Treatment	Rate	Population Averages (Henderson's Percent Control)			
		Pretreatment counts	9 DAT (Visual)	16 DAT (Visual)	21 DAT (Microscope)
Safari 20SG	4 oz	156.5 a	97.5 a (42)	64.8 a (57)	100.8 a (69)
Safari 20SG	8 oz	170.0 a	158.5 a (13)	221.0 a (0)	259.3 a (26)
Safari 20SG – Drench	12 oz	101.0 a	155.7 a (0)	190.3 a (0)	346.7 a (0)
Safari 20SG – Drench	24 oz	190.8 a	216.3 a (0)	125.0 a (32)	205.5 ab (47)
TriStar 30SG	112 g	132.8 a	115.0 a (19)	84.0 a (34)	58.8 bc (78)
TriStar 30SG	124 oz	111.8 a	155.0 a (0)	121.5 a (0)	30.3 cd (87)
Celero	4 oz	197.3 a	210.0 a (0)	210.5 a (0)	209.3 ab (48)
Orthene TTO 97	8 oz	403.0 a	330.0 a (23)	200.0 a (48)	80.0 d (90)
Untreated		160.5 a	171.5 a (0)	154.0 a (0)	328.8 a (0)

* Letters after numbers are based on separation of average number of scale on 5 plants. See trial report in Appendix 3 for statistical separation details.

Comparative Efficacy on Mealybug

Citrus Mealybug. In a study conducted by Oetting for control of citrus mealybug (*Planococcus citri*) on coleus (*Coleus sp.*), most of the tested products provided good to excellent control by 6 weeks after the initial treatment. Those that exhibited excellent control 2 weeks after application included Facin at both 0.25% and 0.5%, Safari drenched at 24 oz per 100 gal, TriStar at 96 oz per 100 gal, and Orthene at 10.5 oz per 100 gal.

Table 14. Efficacy on Citrus Mealybug on Coleus - 1, Ludwig, TX, 2004.

Treatment (Rate)	Population Averages (Henderson's Percent Control)				
	0 DAT	6 DAT	13 DAT	21 DAT	28 DAT
Talus 40SC (21.5 fl oz)	22.8	17.8 abc (21)	27.3 ab (0)	13.8 ab (45)	5.5 b (88)
Talus 40SC (43 fl oz)	10.5	12.0 abcd (0)	23.8 abc (0)	6.8 bc (42)	6.5 bc (68)
Talus 40SC (86 fl oz)	16.5	24.3 abcd (0)	22.8 bcd (0)	1.0 cde (94)	1.8 bc (95)
Safari (12 oz / 100 gal) - Drench	21.5	16.5 abcd (22)	11.3 cdef (24)	3.0 cde (87)	0.0 c (100)
Safari (24 oz / 100 gal) - Drench	17.8	10.8 abcd (38)	2.3 cdefg (81)	1.5 cde (92)	0.3 c (99)
Safari (48 oz / 100 gal) - Drench	11.3	5.5 cd (50)	1.5 defg (81)	0.5 de (96)	0.0 c (100)
Distance (8 oz / 100 gal)	27.0	41.3 ab (0)	57.8 ab (0)	68.3 a (0)	70.0 a (0)
Distance (16 oz / 100 gal)	16.0	37.3 a (0)	58.3 a (0)	58.8 a (0)	62.8 a (0)
Distance (32 oz / 100 gal)	17.0	9.0 bcd (46)	3.3 cdefg (72)	0.0 e (100)	0.0 c (100)
Flagship (2 oz / 100 gal)	27.8	14.5 abcd (47)	9.0 bcd (53)	0.8 cde (98)	0.8 bc (99)
Flagship (4 oz / 100 gal)	28.3	5.8 cd (79)	1.3 efg (94)	0.3 e (99)	0.0 c (100)
Flagship (8 oz / 100 gal)	30.8	4.3 cd (86)	0.5 fg (98)	0.0 e (100)	0.0 c (100)
TriStar 70WSP (32 g / 100 gal)	11.8	4.0 cd (65)	3.0 cdefg (63)	0.8 cde (94)	0.0 c (100)
TriStar 70WSP (64 g / 100 gal)	15.0	3.0 cd (80)	1.0 defg (90)	0.0 e (100)	0.0 c (100)
TriStar 70WSP (128 g / 100 gal)	21.8	1.3 d (94)	0.0 g (100)	0.3 e (99)	0.0 c (100)
Untreated	27.8	27.3 abcd (0)	19.0 bcde (0)	30.5 bcd (0)	54.0 a (0)

* Letters after numbers are based on separation of average number of mealybug on the same 2 inches of stem. See trial report in Appendix 3 for statistical separation details.

Table 15. Efficacy on Citrus Mealybug on Coleus - 2, Ludwig, TX, 2004.

Treatment (Rate)	Population Averages (Henderson's Percent Control)			
	0 DAT	17 DAT	22 DAT	28 DAT
Talus 40SC (21.5 fl oz)	19.0	18.5 abc (37)	0.3 ab (99)	0.3 ab (99)
Talus 40SC (43 fl oz)	33.5	21.3 abcd (59)	3.8 abc (94)	0.8 bc (99)
Talus 40SC (86 fl oz)	43.3	39.3 abcd (42)	4.3 bcd (95)	3.8 cde (95)
Safari (12 oz / 100 gal) - Drench	47.3	34.3 abcd (53)	0.0 cdef (100)	0.0 cde (100)
Safari (24 oz / 100 gal) - Drench	37.8	24.5 abcd (58)	0.3 cdefg (100)	0.3 cde (100)
Safari (48 oz / 100 gal) - Drench	27.8	41.5 cd (4)	1.0 defg (98)	1.5 de (97)
Distance (8 oz / 100 gal)	135.0	74.8 ab (64)	16.8 ab (93)	7.3 a (97)
Distance (16 oz / 100 gal)	24.3	11.0 a (71)	4.8 a (90)	1.5 a (96)
Distance (32 oz / 100 gal)	19.8	14.8 bcd (52)	2.8 cdefg (93)	6.3 e (82)
Flagship (2 oz / 100 gal)	53.3	18.5 abcd (78)	3.0 bcd (97)	2.5 cde (97)
Flagship (4 oz / 100 gal)	41.8	10.3 cd (84)	0.5 efg (99)	0.0 e (100)
Flagship (8 oz / 100 gal)	25.5	37.3 cd (6)	9.0 fg (81)	5.0 e (89)
TriStar 70WSP (32 g / 100 gal)	28.0	17.0 cd (61)	0.3 cdefg (100)	0.0 cde (100)
TriStar 70WSP (64 g / 100 gal)	19.0	14.0 cd (53)	0.3 defg (99)	0.0 e (100)
TriStar 70WSP (128 g / 100 gal)	28.5	16.8 d (62)	0.3 g (100)	0.0 e (100)
Untreated	26.0	40.5 abcd (0)	49.0 bcde (0)	45.8 bcd (0)

* Letters after numbers are based on separation of average number of mealybug on the same 10 leaves throughout the experiment. See trial report in Appendix 3 for statistical separation details.

Table 16. Efficacy on Citrus Mealybug on Coleus, Oetting, GA, 2005.

Treatment	Rate (per 100 gal)	Pre Treatment Rating	Percent Control (Henderson's)				
			Week 2	Week 3	Week 4	Week 5	Week 6
Aria (flonicamid)	60 g	2.6 cde	37 ab	72 bcde	88 cdef	89 def	89 e
Aria (flonicamid)	120 g	4.3 abcde	81 bcde	93 def	100 f	98 f	99 e
Facin	0.25%	2.4 de	96 e	82 bc	84 bc	79 b	80 bc
Facin	0.50%	3.8 abcde	93 de	81 b	88 bcd	91 cd	87 bc
Flagship (thiamethoxam)	2 oz	2.4 de	52 bcd	91 ef	93 def	87 cdef	92 e
Flagship (thiamethoxam)	4 oz	3.8 abcde	79 bcde	86 cdef	96 def	97 ef	98 e
Safari (dinotefuran)	4 oz	3.1 cde	65 bcde	73 bc	81 bcde	85 cde	81 cd
Safari (dinotefuran)	8 oz	2.9 cde	46 ab	73 bcd	71 b	77 bc	67 b
Safari (dinotefuran) – drench	12 oz	4.5 abcd	68 abc	96 f	96 def	97 ef	100 e
Safari (dinotefuran) - drench	24 oz	2.8 cde	94 e	94 f	97 f	98 f	100 e
Talus (buprofezin)	21.5 oz	3.7 bcde	67 bcde	83 bcdef	95 def	98 f	99 e
Talus (buprofezin)	43 oz	2.1 e	49 bcde	80 cdef	84 cdef	95 f	97 e
TriStar (acetamiprid)	48 oz	5.9 ab	86 bcde	95 def	95 cdef	98 ef	97 e
TriStar (acetamiprid)	96 oz	4.8 abc	92 de	96 f	97 ef	96 def	95 de
Orthene (acephate)	10.5 oz	6.1 a	92 cde	96 def	98 ef	98 ef	97 e
Untreated		2.1 e	0 a	0 a	0 a	0 a	0 a
Untreated (Population Rating)		2.1	10.2	16.6	20.8	28.5	38.7

* Letters after numbers are based on separation of raw whole plant population rating. See trial report in Appendix 3 for statistical separation details.

Madeira Mealybug. In a single trial conducted by Oetting to control Madeira mealybug (*Phenacoccus madeirensis*) on coleus (*Coleus sp.*), Talus at 21.5 and 43 oz per 100 gal, TriStar at 48 oz + Capsil at 6 oz per 100 gal, and Orthene at 10.5 oz per 100 gal provided the best control by 6 weeks after initial application. However, products did not begin to provide good to excellent control until 3 weeks after initial applications. The addition of Capsil at 6 oz enhanced the level of control of both Safari at 4 oz and TriStar at 48 oz.

Table 17. Efficacy on Madeira Mealybug on Coleus, Oetting, GA, 2005.

Treatment	Rate (per 100 gal)	Pre Treatment Rating	Percent Control (Henderson's)				
			Week 2	Week 3	Week 4	Week 5	Week 6
Facin	0.25%	12.3 ab	26 abc	42 bc	54 bc	50 bc	55 bc
Facin	0.50%	12.9 ab	1 a	39 bc	47 bc	62 cd	75 cd
Safari (dinotefuran)	4 oz	4.8 d	46 a	65 bc	70 bc	80 cde	71 bc
Safari (dinotefuran) +Capsil	4 oz +6 oz	9.6 abc	62 abc	62 bc	90 cd	91 def	82 cd
Talus (buprofezin)	21.5 oz	13.5 a	29 bcd	90 d	95 d	98 f	98 d
Talus (buprofezin)	43 oz	8.7 bcd	62 bcd	82 cd	97 d	96 ef	98 d
TriStar (acetamiprid)	48 oz	7.0 cd	55 abc	34 a	49 a	57 ab	57 ab
TriStar (acetamiprid)	96 oz	6.0 cd	19 a	42 bc	57 bc	58 bc	42 ab
TriStar (acetamiprid) +Capsil	48 oz+6 oz	7.4 cd	53 cd	77 cd	61 cd	95 ef	93 d
Orthene (acephate)	10.5 oz	7.1 cd	78 d	93 d	100 d	100 f	99 d
Untreated		6.4 cd	0 a	0 a	0 a	0 a	0 a
Untreated (Population Rating)		6.4	16.8	13.3	12.3	16.2	15.3

* Letters after numbers are based on separation of raw whole plant population rating. See trial report in Appendix 3 for statistical separation details.

Mexican Mealybug. In a single trial conducted by Smitley & Davis, all products tested provided good to excellent control starting 17 days after initial applications with excellent control continuing through the end of the experiment at 38 days after initial applications.

Table 18. Efficacy on Mexican Mealybug on Marigold, Smitley & Davis, MI, 2005

Treatment	Rate	Henderson's Percent Control					
		Pre Treatment Count	7 DAT	17 DAT	25 DAT	33 DAT	38 DAT
Aria 50SG	60 g	21.0	90	93	100	100	100
Aria 50SG	120 g	17.3	91	95	98	100	100
Flagship 25WP	2 oz	17.0	0	81	99	100	93
Flagship 25WP	4 oz	16.2	68	95	100	100	100
Safari 20SG	4 oz	18.7	71	98	99	100	100
Safari 20SG	8 oz	15.8	49	93	99	100	100
Safari 20SG - Drench	12 oz	17.8	70	84	95	96	100
Safari 20SG - Drench	24 oz	17.2	27	80	97	100	99
Talus 40SC	18 fl oz	19.7	10	66	98	99	99
TriStar 30SG	112 g	18.5	56	90	98	97	97
TriStar 30SG	224 g	17.5	80	83	99	89	96
Orthene 97	1 lb	16.0	95	100	100	100	100
Untreated		20.5	0	0	0	0	0
Untreated (Population Average)		20.5	105.3	221.0	240.3	323.8	489.8

*B-1956 surfactant mixed with Flagship, Safari, TriStar and Orthene foliar applications.

Phormium Mealybug. In one trial with Phormium mealybug (*Balanococcus diminutus*) on New Zealand flax 'Dazler' (*Phormium tenax*), both adults and nymphs were assessed. Very few adults were observed, so the remaining discussion will be on total live counts. Flagship 25WG applied as a foliar spray provided good to great control from 8 DAT to 43 DAT. Precise, commonly used for this pest, only provided approximately 50% control 4 and 6 weeks after treatment. Safari 20SG provided excellent control (>95%) at 4 and 6 weeks after treatment with the exception of Safari 20SG drenched at 24 oz per 100 gallon at 6 WAT, which due to a single outlier data point. TriStar 70WSP exhibited good to excellent control throughout this experiment.

Table 19. Efficacy on Phormium Mealybug on New Zealand Flax, Bethke, CA, 2005.

Scale Stage	Treatment	Rate per 100 gal	Population Averages (Henderson's Percent Control)				
			Pre-treatment counts	8 DAT	15 DAT	29 DAT	43 DAT
Live Nymphs	Flagship 25WG	2 oz	41.0 a	10.7 (83)	0.3 (99)	13.2 (85)	0.5 (98)
	Flagship 25WG	4 oz	45.5 a	0.0 (100)	1.2 (98)	0.5 (99)	0.0 (100)
	Precise	1 tbs per pot	36.7 a	33.5 (40)	77.0 (0)	33.7 (57)	14.8 (42)
	Safari 20SG	4 oz	30.7 a	14.5 (69)	15.7 (67)	0.0 (100)	0.2 (99)
	Safari 20SG	8 oz	9.5 a	23.5 (0)	1.3 (91)	0.0 (100)	0.0 (100)
	Safari 20SG – Drench	12 oz	22.5 a	6.3 (82)	0.8 (98)	0.2 (100)	0.7 (96)
	Safari 20SG – Drench	24 oz	15.8 a	23.8 (1)	19.2 (21)	1.2 (97)	6.7 (40)
	TriStar 70WSP	4 oz	37.5 a	4.7 (92)	2.2 (96)	0.0 (100)	1.2 (96)
	TriStar 70WSP	8 oz	42.7 a	11.3 (83)	1.7 (97)	0.0 (100)	1.5 (95)
	Untreated		33.2 a	50.7 (0)	50.7 (0)	70.7 (0)	23.3 (0)
Live Adults	Flagship 25WG	2 oz	1.0 a	0.0 (100)	29.7 (0)	0.0 (100)	0.0 (100)
	Flagship 25WG	4 oz	2.0 a	0.0 (100)	18.8 (0)	0.0 (100)	0.0 (100)
	Precise	1 tbs per pot	3.0 a	1.7 (76)	10.3 (0)	5.7 (0)	1.3 (92)
	Safari 20SG	4 oz	3.0 a	0.5 (93)	11.2 (0)	0.0 (100)	0.2 (99)
	Safari 20SG	8 oz	1.3 a	0.2 (95)	15.0 (0)	0.0 (100)	0.2 (98)
	Safari 20SG – Drench	12 oz	4.2 a	0.2 (98)	11.8 (0)	0.0 (100)	0.0 (100)
	Safari 20SG – Drench	24 oz	0.5 a	0.2 (85)	7.5 (0)	0.0 (100)	0.3 (88)
	TriStar 70WSP	4 oz	1.2 a	0.0 (100)	9.2 (0)	0.7 (0)	0.5 (93)
	TriStar 70WSP	8 oz	0.3 a	0.7 (13)	3.7 (0)	0.0 (100)	0.0 (100)
Untreated		1.2 a	2.7 (0)	2.7 (0)	0.3 (0)	6.7 (0)	
Total Live	Flagship 25WG	2 oz	42.0 a	10.7 cd (84)	30.0 bc (54)	13.2 c (85)	0.5 d (99)
	Flagship 25WG	4 oz	47.5 a	0.0 d (100)	20.0 c (73)	0.5 c (99)	0.0 d (100)
	Precise	1 tbs per pot	39.7 a	35.2 ab (43)	87.3 a (0)	39.3 b (52)	16.2 b (53)
	Safari 20SG	4 oz	33.7 a	15.0 bcd (71)	26.8 bc (49)	0.0 c (100)	0.3 d (99)
	Safari 20SG	8 oz	10.8 a	23.7 bc (0)	16.3 c (3)	0.0 c (100)	0.2 d (98)
	Safari 20SG – Drench	12 oz	26.7 a	6.5 cd (84)	12.7 c (69)	0.2 c (100)	0.7 d (97)
	Safari 20SG – Drench	24 oz	16.3 a	24.0 bc (5)	26.7 abc (0)	1.2 c (97)	7.0 bc (51)
	TriStar 70WSP	4 oz	38.7 a	4.7 cd (92)	11.3 c (81)	0.7 c (99)	1.7 d (95)
	TriStar 70WSP	8 oz	43.0 a	12.0 cd (82)	5.3 c (92)	0.0 c (100)	1.5 cd (96)
Untreated		34.3 a	53.3 a (0)	53.3 ab (0)	71.0 a (0)	30.0 a (0)	

* Letters after numbers are based on separation of average number of scale on 5 plants. See trial report in Appendix 3 for statistical separation details.

Efficacy Summary by Active Ingredient

Flagship 25WP. Flagship at both rates provided excellent efficacy on elongate hemlock scale and cryptomeria scale, mediocre to good efficacy on cottony maple scale, and poor efficacy on oystershell scale (Tables 11, 2, 9 and 10). On Florida wax scale, overall efficacy was excellent although mixed results were obtained in 3 trials, with good efficacy on nymphs and excellent efficacy on adults at both rates in one trial, minimal impact on nymphs and excellent efficacy on adults at both rates in another trial, and minimal impact on adults and excellent efficacy on nymphs at the higher rate in a third trial (Tables 6-8). Better control of Fletcher scale was obtained with banded vs. foliar application (Table 5). Euonymus scale control was mediocre in a 2004 trial and comparable or better than Orthene in 2005 (Tables 3-4). Flagship at both rates provided good to excellent efficacy on citrus mealybug and Mexican mealybug (Tables 12 and 14).

Safari 20SG. Safari at both rates foliar or drench provided excellent efficacy on elongate hemlock scale and cryptomeria scale, mediocre to good efficacy on Fletcher scale, and poor efficacy on cottony cushion scale and Euonymus scale (Tables 11, ?, 1, 3 and 4). On oystershell scale, Safari at both rates provided excellent efficacy when applied as drench but poor efficacy when applied foliar (Tables 9-10). Cottony maple scale efficacy was poor to mediocre with foliar and none to poor with drench application (Table 2). Safari at both rates provided good efficacy on Madeira mealybug when applied foliar and excellent efficacy on Mexican mealybug applied foliar or drench (Tables 13 and 14). On citrus mealybug, drench performed better than foliar application (Table 12).

Talus 40SC. Talus at 21.5 fl oz/100gal provided excellent efficacy on elongate hemlock scale, cryptomeria scale and oystershell scale (Tables 11, 9 and 10). Good efficacy was obtained on Fletcher scale and Euonymus scale (Tables 5, 3 and 4). It provided poor efficacy on Florida wax scale and cottony maple scale (Tables 6-8 and 2). Talus provided excellent efficacy on Madeira mealybug, citrus mealybug and Mexican mealybug (Tables 12-14).

TriStar 70WSP. TriStar at both rates provided excellent efficacy on elongate hemlock scale and cryptomeria scale (Table 11). On Florida wax scale, overall efficacy was excellent although mixed results were obtained in 3 trials, with good efficacy on nymphs and excellent efficacy on adults at both rates in one trial, minimal impact on nymphs and excellent efficacy on adults at both rates in another trial, and minimal impact on adults and excellent efficacy on nymphs in a third trial (Tables 6-8). Good efficacy on Fletcher scale was obtained with the higher rate and on cottony cushion scale with both rates (Tables 5 and 1). Efficacy was generally none to mediocre on Euonymus scale, cottony maple scale and oystershell scale (Tables 3, 4, 2, 9 and 10). Both rates of TriStar provided excellent efficacy on citrus mealybug and Mexican mealybug (Tables 12 and 14). A trial on Madeira mealybug showed excellent control when TriStar was mixed with Capsil surfactant and poor control without Capsil (Table 13).

BYI 8330. BYI 8330 at 20 fl oz/100 gal provided some reduction in Euonymus scale counts on winged burning bush in one trial (Table 3).

Celero 16WSG. Celero at 4 oz/100gal provided poor efficacy on cottony cushion scale and mixed results in 3 trials on Florida wax scale with minimal to excellent efficacy on nymphs and adults (Tables 1, 6-8).

Discus. In one yew trial, Discus foliar provided good efficacy on Fletcher scale (Table 5).

Distance 0.86E. Distance at 32 oz/100 gal provided poor efficacy on Fletcher scale but good efficacy on Euonymus scale (Tables 5 and 3).

Facin. Facin provided good efficacy on Madeira mealybug at 0.5 % rate and excellent efficacy on citrus mealybug at 0.25 and 0.5 % rates (Tables 12 and 13).

Please see Table 15 for a list of all researchable studies and the summary of trials conducted in 2005.

Phytotoxicity

No phytotoxicity was observed with any treatments by any researcher with the exception of Precise on Phormium (*Phormium tenax*).

Table 20. Summary of Efficacy By Product

Note: Table entries are sorted by crop Latin name. Only those trials received by 6/23/2006 are included in the table below.

PR #	Product	Pest		Crop		Production Site	Researcher(s)	Results Summary
		Common Name	Latin Name	Common Name	Latin Name			
25083	Aria 50SG	Citrus Mealybug	<i>Planococcus citri</i>	Flamenettle	<i>Coleus sp.</i>	Greenhouse	Oetting	Excellent efficacy at 120g per 100 gal
24898	Aria 50SG	Mexican Mealybug	<i>Phenacoccus gossypii</i>	Marigold	<i>Tagetes patula</i>	Greenhouse	Davis & Smitley	Excellent efficacy at 60 g and 120 g per 100 gal
25149	BYI 8330	Euonymus Scale	<i>Unaspis euonymi</i>	Winged burning bush	<i>Euonymus alata</i>	Field Container	Freiberger	Some reduction in scale counts at 20 fl oz per 100 gal
25731	Celero 16WSG	Cottony Cushion Scale	<i>Icerya purchasi</i>	Cleyera	<i>Ternstroemia gymnanthera</i>	Greenhouse	Ludwig	Poor efficacy at 4 oz per 100 gallon rate
25729	Celero 16WSG	Florida Wax Scale	<i>Ceroplastes floridensis</i>	Holly, Dwarf Buford	<i>Ilex cornuta 'bufordii nana'</i>	Field Container	Ludwig	Minimal impact on nymphs; excellent efficacy on adults by 56 DAT at 4 oz per 100 gal
25729	Celero 16WSG	Florida Wax Scale	<i>Ceroplastes floridensis</i>	Holly, 'China Doll'	<i>Ilex cornuta 'bufordii nana'</i>	Field Container	Ludwig	Minimal impact on adults; some efficacy on nymphs at 14 DAT at 4 oz per 100 gal
25773	Celero 16WSG	Florida Wax Scale	<i>Ceroplastes floridensis</i>	Indian Hawthorn	<i>Rhaphiolepis indica</i>	Field Container	Ludwig	By 41 DAT, excellent efficacy on nymphs and on adults at 4 oz per 100 gal
25165	Discus	Fletcher Scale	<i>Lecanium fletcheri</i>	Yew	<i>Taxus media</i>	Field Inground	Davis & Smitley	Good efficacy
25164	Distance 0.86E	Fletcher Scale	<i>Lecanium fletcheri</i>	Yew	<i>Taxus media</i>	Field Inground	Davis & Smitley	Poor efficacy
25151	Distance 0.86E	Euonymus Scale	<i>Unaspis euonymi</i>	Winged burning bush	<i>Euonymus alata</i>	Field Container	Freiberger	Good efficacy at 32 oz per 100 gal; lower rates were not effective
25085	Facin	Citrus Mealybug	<i>Planococcus citri</i>	Flamenettle	<i>Coleus sp.</i>	Greenhouse	Oetting	Excellent efficacy at both 0.25% and 0.5% rates
25068	Facin	Madeira Mealybug	<i>Phenacoccus madeirensis</i>	Flamenettle	<i>Coleus sp.</i>	Greenhouse	Oetting	At 0.5% rate good efficacy, but not as good as standards
25084	Flagship 25WG	Citrus Mealybug	<i>Planococcus citri</i>	Flamenettle	<i>Coleus sp.</i>	Greenhouse	Oetting	Good to excellent efficacy at both 2 oz and 4 oz per 100 gal from 3 weeks after treatment
24897	Flagship 25WG	Mexican Mealybug	<i>Phenacoccus gossypii</i>	Marigold	<i>Tagetes patula</i>	Greenhouse	Davis & Smitley	Good to excellent efficacy by 17 DAT

PR #	Product	Pest		Crop		Production Site	Researcher(s)	Results Summary
		Common Name	Latin Name	Common Name	Latin Name			
25152	Flagship 25WG	Euonymus Scale	<i>Unaspis euonymi</i>	Winged burning bush	<i>Euonymus alata</i>	Field Container	Freiberger	2004: Some reduction in scale counts at 4 and 8 oz per 100 gal rates 2005: Efficacy comparable or better than Orthene at the 4 oz per 100 gal rate
25132	Flagship 25WG	Fletcher Scale	<i>Lecanium fletcheri</i>	Yew	<i>Taxus media</i>	Field Inground	Davis & Smitley	Best control achieved with banded application
25771	Flagship 25WG	Florida Wax Scale	<i>Ceroplastes floridensis</i>	Indian Hawthorn	<i>Rhaphiolepis indica</i>	Field Container	Ludwig	By 41 DAT, good efficacy on nymphs and great efficacy on adults at both rates
25052	Flagship 25WG	Florida Wax Scale	<i>Ceroplastes floridensis</i>	Holly, Dwarf Buford	<i>Ilex cornuta 'bufordii nana'</i>	Field Container	Ludwig	Minimal impact on nymphs; excellent efficacy on adults by 56 DAT at both 2 and 4 oz per 100 gal
25052	Flagship 25WG	Florida Wax Scale	<i>Ceroplastes floridensis</i>	Holly, 'China Doll'	<i>Ilex cornuta 'bufordii nana'</i>	Field Container	Ludwig	Minimal impact on adults; great efficacy on nymphs at 14 DAT at 4 oz per 100 gal
25314	Flagship 25WP	Elongate Hemlock Scale and Cryptomeria Scale	<i>Fiorinia externa</i>	Frasier Fir	<i>Abies fraseri</i>	Field Inground	Cowles	Excellent efficacy
25133	Flagship 25WG	Oystershell Scale	<i>Lepidosaphes ulmi</i>	Tree Lilac, 'Sensation'	<i>Syringa vulgaris</i>	Field Inground	Nielsen	Poor efficacy
25134	Flagship 25WG	Oystershell Scale	<i>Lepidosaphes ulmi</i>	Carolina Silverbell	<i>Halesia carolina</i>	Field Inground	Nielsen	Poor efficacy
25444	Flagship 25WG	Cottony Maple Scale	<i>Pulvinaria innumerabilis</i>	Silver Maple	<i>Acer saccharinum</i>	Field Inground	Davis & Smitley	Mediocre to good efficacy
25071	Safari 20SG	Citrus Mealybug	<i>Planococcus citri</i>	Flamenettle	<i>Coleus sp.</i>	Greenhouse	Oetting	Drench applications performed significantly better than foliar applications
25137	Safari 20SG	Mexican Mealybug	<i>Phenacoccus gossypii</i>	Marigold	<i>Tagetes patula</i>	Greenhouse	Davis & Smitley	Excellent efficacy by 17 DAT with foliar, by 25 DAT with drench applications
25065	Safari 20SG	Madeira Mealybug	<i>Phenacoccus madeirensis</i>	Flamenettle	<i>Coleus sp.</i>	Greenhouse	Oetting	With and without Capsil, provided good efficacy
25060	Safari 20SG	Cottony Cushion Scale	<i>Icerya purchasi</i>	Cleyera	<i>Ternstroemia gymnanthera</i>	Greenhouse	Ludwig	Poor efficacy with both foliar and drench applications
25315	Safari 20SG	Elongate Hemlock Scale and Cryptomeria Scale	<i>Fiorinia externa</i>	Frasier Fir	<i>Abies fraseri</i>	Field Inground	Cowles	Excellent efficacy with drenches providing 100% control
25139	Safari 20SG	Fletcher Scale	<i>Lecanium fletcheri</i>	Yew	<i>Taxus media</i>	Field Inground	Davis & Smitley	Mediocre to good efficacy

PR #	Product	Pest		Crop		Production Site	Researcher(s)	Results Summary
		Common Name	Latin Name	Common Name	Latin Name			
25153	Safari 25SG	Euonymus Scale	<i>Unaspis euonymi</i>	Winged burning bush	<i>Euonymus alata</i>	Field Container	Freiberger	2004: Drench rates applied foliarly, but no efficacy 2005: Little to no control with either foliar or drench applications
25140	Safari 25SG	Oystershell Scale	<i>Lepidosaphes ulmi</i>	Tree Lilac, 'Sensation'	<i>Syringa vulgaris</i>	Field Inground	Nielsen	Poor efficacy with foliar, excellent efficacy with drench application
25141	Safari 25SG	Oystershell Scale	<i>Lepidosaphes ulmi</i>	Carolina Silverbell	<i>Halesia carolina</i>	Field Inground	Nielsen	No control with foliar, 100 % control with drench application
25445	Safari 25SG	Cottony Maple Scale	<i>Pulvinaria innumerabilis</i>	Silver Maple	<i>Acer saccharinum</i>	Field Inground	Davis & Smitley	Poor to mediocre efficacy with foliar, no to poor efficacy with drench application
25070	Talus 40SC	Citrus Mealybug	<i>Planococcus citri</i>	Flamenettle	<i>Coleus sp.</i>	Greenhouse	Oetting	Excellent efficacy from 4 weeks after treatment
25142	Talus 40SC	Mexican Mealybug	<i>Phenacoccus gossypii</i>	Marigold	<i>Tagetes patula</i>	Greenhouse	Davis & Smitley	Excellent efficacy by 25 DAT
25064	Talus 40SC	Madeira Mealybug	<i>Phenacoccus madeirensis</i>	Flamenettle	<i>Coleus sp.</i>	Greenhouse	Oetting	Both 21.5 and 43 oz per 100 gal provided excellent control
25154	Talus 40SC	Euonymus Scale	<i>Unaspis euonymi</i>	Winged burning bush	<i>Euonymus alata</i>	Field Container	Freiberger	2004: Excellent control 2005: Efficacy comparable to Orthene
25316	Talus 40SC	Elongate Hemlock Scale and Cryptomeria Scale	<i>Fiorinia externa</i>	Frasier Fir	<i>Abies fraseri</i>	Field Inground	Cowles	Excellent efficacy
25156	Talus 40SC	Fletcher Scale	<i>Lecanium fletcheri</i>	Yew	<i>Taxus media</i>	Field Inground	Davis & Smitley	Mediocre to good efficacy
25049	Talus 40SC	Florida Wax Scale	<i>Ceroplastes floridensis</i>	Holly, 'China Doll'	<i>Ilex cornuta 'bufordii nana'</i>	Field Container	Ludwig	Minimal impact on adults; some efficacy on nymphs at 14 DAT at 21.5 fl oz per 100 gal
25163	Talus 70WP	Fletcher Scale	<i>Lecanium fletcheri</i>	Yew	<i>Taxus media</i>	Field Inground	Davis & Smitley	Mediocre to good efficacy
25144	Talus 40SC	Oystershell Scale	<i>Lepidosaphes ulmi</i>	Tree Lilac, 'Sensation'	<i>Syringa vulgaris</i>	Field Inground	Nielsen	Excellent efficacy
25143	Talus 40SC	Oystershell Scale	<i>Lepidosaphes ulmi</i>	Carolina Silverbell	<i>Halesia carolina</i>	Field Inground	Nielsen	Excellent efficacy
25446	Talus 40SC	Cottony Maple Scale	<i>Pulvinaria innumerabilis</i>	Silver Maple	<i>Acer saccharinum</i>	Field Inground	Davis & Smitley	Poor efficacy
25069	TriStar	Citrus Mealybug	<i>Planococcus citri</i>	Flamenettle	<i>Coleus sp.</i>	Greenhouse	Oetting	Excellent efficacy at both rates
25205	TriStar 30SG	Mexican Mealybug	<i>Phenacoccus gossypii</i>	Marigold	<i>Tagetes patula</i>	Greenhouse	Davis & Smitley	Excellent efficacy by 25 DAT

PR #	Product	Pest		Crop		Production Site	Researcher(s)	Results Summary
		Common Name	Latin Name	Common Name	Latin Name			
25063	TriStar	Madeira Mealybug	<i>Phenacoccus madeirensis</i>	Flamenettle	<i>Coleus sp.</i>	Greenhouse	Oetting	Without Capsil poor efficacy; with Capsil provided great efficacy
25117	TriStar	Fletcher Scale	<i>Lecanium fletcheri</i>	Yew	<i>Taxus media</i>	Field Inground	Davis & Smitley	Good efficacy
25058	TriStar 30SG	Cottony Cushion Scale	<i>Icerya purchasi</i>	Cleyera	<i>Ternstroemia gymnanthera</i>	Greenhouse	Ludwig	Good efficacy with 124 oz per 100 gallon rate almost to the level of Orthene TTO 97 standard
25772	TriStar 30SG	Florida Wax Scale	<i>Ceroplastes floridensis</i>	Indian Hawthorn	<i>Rhaphiolepis indica</i>	Field Container	Ludwig	By 41 DAT, excellent efficacy on nymphs and adults at both rates
25219	TriStar 30SG	Florida Wax Scale	<i>Ceroplastes floridensis</i>	Holly, Dwarf Buford	<i>Ilex cornuta 'bufordii nana'</i>	Field Container	Ludwig	Minimal impact on nymphs; excellent efficacy on adults by 56 DAT at both 4 and 8 oz per 100 gal
25219	TriStar 30SG	Florida Wax Scale	<i>Ceroplastes floridensis</i>	Holly, 'China Doll'	<i>Ilex cornuta 'bufordii nana'</i>	Field Container	Ludwig	Minimal impact on adults; excellent efficacy on nymphs at 28 DAT at 4 oz and 8 oz per 100 gal
25317	TriStar 70WSP	Elongate Hemlock Scale and Cryptomeria Scale	<i>Fiorinia externa</i>	Frasier Fir	<i>Abies fraseri</i>	Field Inground	Cowles	Excellent efficacy
25155	TriStar 70WSP	Euonymus Scale	<i>Unaspis euonymi</i>	Winged burning bush	<i>Euonymus alata</i>	Field Container	Freiberger	2004: Some efficacy at 64 g per 100 gal rate. 2005: Little efficacy at either rate
25146	TriStar 70WSP	Oystershell Scale	<i>Lepidosaphes ulmi</i>	Tree Lilac, 'Sensation'	<i>Syringa vulgaris</i>	Field Inground	Nielsen	No to poor efficacy
25147	TriStar 70WSP	Oystershell Scale	<i>Lepidosaphes ulmi</i>	Carolina Silverbell	<i>Halesia carolina</i>	Field Inground	Nielsen	No control at 48 g/100 gal, good control at 96 g/100 gal
25447	TriStar 30SG	Cottony Maple Scale	<i>Pulvinaria innumerabilis</i>	Silver Maple	<i>Acer saccharinum</i>	Field Inground	Davis & Smitley	No to mediocre efficacy

Label Suggestions

Based upon data accumulated through the IR-4 research program in 2004-2005, we suggest that companies consider adding the following scale and mealybug species to their current product labels:

- Flagship – Elongate hemlock scale, Cryptomeria scale, Florida wax scale, Citrus mealybug, Mexican mealybug
- Safari - Elongate hemlock scale, Cryptomeria scale, Oystershell scale (drench application only), Citrus mealybug, Madeira mealybug, Mexican mealybug
- Talus - Elongate hemlock scale, Cryptomeria scale, Euonymus scale, Madeira mealybug
- TriStar - Elongate hemlock scale, Cryptomeria scale, Cottony cushion scale, Mexican mealybug
- Aria - Citrus mealybug, Mexican mealybug

Appendix 1: Protocols

CONTROL OF SCALES/MEALY BUGS ON ORNAMENTAL PLANTS WITH FOLIAR OR DRENCH APPLICATIONS OF TALUS, SAFARI, DISTANCE, FLAGSHIP AND TRISTAR

Date: 11/04

Ornamental Protocol Number: 003

General label directions: Refer to product labels. Depending on the product, use either a foliar or drench application for this study.

Research program:

Pest(s)/Plants – Scale or mealy bugs.

Pesticide (common name and trade name): Refer to treatment list shown below.

For label, material & if needed spray oil surfactant contact:

Syngenta, Dave Ross, 336-632-6411, david.ross@syngenta.com (Flagship)

SePro, Michelle Bell, 317-580-8097, michelleb@sepro.com (Talus)

Valent, Joe Chamberlin, 770-985-0303, jcham@valent.com (Safari and Distance)

Cleary, Rick Fletcher, 732-329-8399, rick.fletcher@clearvchemical.com (TriStar)

Experimental design:

Plot size (must be adequate to reflect actual use condition)

Replicates Minimum of 4 Treatment Units

Controls (untreated controls to be included in all experiments)

Application: **TALUS 70WP*** **TALUS 40SC*** **SAFARI 20SG**** **DISTANCE 0.86E*** **FLAGSHIP 25WP*** **TRISTAR 70WSP***

Dosages: 1x 14 oz/100 gal. 21.5 fl.oz/100 gal. 12 oz/100 gal. 8 oz/100 gal. 2 oz/100 gal. 32 grams/100 gal.

2x 28 oz/100 gal. 43.0 fl.oz/100 gal. 24 oz/100 gal. 16 oz/100 gal. 4 oz/100 gal. 64 grams/100 gal.

4x 56 oz/100 gal. 86.0 fl.oz/100 gal. 48 oz/100 gal. 32 oz/100 gal. 8 oz/100 gal. 128 grams/100 gal.

*** Use an appropriate spreader/sticker to ensure proper deposition on plant or insect.**

**** Apply Safari as a drench treatment. Contact Joe Chamberlin, Valent, for pot size drench recommendations.**

Active Ingredients: Talus (buprofezin), Safari (dimotefuran), Distance (pyriproxyfen), Flagship (thiamethoxam), TriStar (acetamiprid).

Volume: Minimum of 10 gal/A for liquid applications.

Timing: 2 Applications, 14 Day Spray Interval. Take initial counts, then efficacy and crop safety at 7, 14 (then 2nd appl.) 28 and 42 DAT.

Reports:

Method of application: Treatments should be applied according to product label instructions. application equipment consistent with conventional commercial equipment. Report completely on experimental design and method of application. Report plant size height x width before treatment and throughout the experiment.

Weather: Maintain temperature and precipitation (including irrigation) data.

Soil type: Identify soil type used in experimental area.

Product: When submitting data, include EPA registration number of product used.

Efficacy: Data should include both actual counts and percent control as well as an indication that infestation was light, heavy, etc. Record all application and evaluation dates.

Phytotoxicity: Record phytotoxicity data at all rates. Use a 0-10 scale. 0 = No Phytotoxicity 10 = complete kill.

Please direct questions to: Ely Vea, 308 Aston Forest Lane, Crownsville, MD 21032, Phone & FAX#: 410-923-488, E-mail: evvea@comcast.net.

**Efficacy of Flagship 25WP, Safari 20SG, Talus 40SC, and Tristar 20WSP
for Managing Scale Insects
04/19/05**

Ornamental Protocol Number: 05-002a

Objective: Determine efficacy of Flagship, Safari, Talus and Tristar on scale insects of ornamental plants.

Experimental Design:

Plot Size: Must be adequate to reflect actual use conditions.

Replicates: Minimum of 4 replications

Application Instructions: For foliar applications, make two applications 14 days apart using a volume per acre suitable to provide adequate coverage of plant material. For drench applications of Safari 20SG, follow application guidelines in the table below conducting either 5a and 6a OR 5b and 6b based on whether plant material is in containers or in the ground. Applications should be made using application equipment consistent with conventional commercial equipment. Rates are in formulated product.

Target Species: See attached list of target species.

Plant Hosts: Use a plant host suitable for target scale species, recording species and variety used.

Use Site: May be greenhouse, field container or field in-ground. Please specify in final report.

Evaluations: Record initial insect counts and then 7, 14 (prior to 2nd application), 28 and 42 days after initial application. Record phytotoxicity at each rating date on a scale of 0 to 10 (0 = no phytotoxicity; 10 = complete kill). If phytotoxicity is observed in treated plants, take pictures comparing treated and untreated plant material.

Recordkeeping: Keep detailed records of weather conditions including temperature and precipitation, soil-type or soil-less media, application equipment, application volume per acre, irrigation, liner size, plant height & width, and plant growth stage at application and data collection dates.

Treatments:

#	Product	Rate	Application Instructions
1	Flagship 25WP (thiamethoxam)	2.0 oz/100 gal	Two foliar applications 14 d apart. On hard to wet plants use a wetting agent, do not use surfactants/adjuvants that binds Flagship to the leaf surface.
2	Flagship 25WP (thiamethoxam)	4.0 oz/100 gal	Two foliar applications 14 d apart. On hard to wet plants use a wetting agent, do not use surfactants/adjuvants that binds Flagship to the leaf surface.
3	Safari 20SG (dinotefuran) – Foliar	4.0 oz/100 gal	Two foliar applications 14 d apart with a nonionic surfactant, preferably Capsil.
4	Safari 20SG (dinotefuran) – Foliar	8.0 oz/100 gal	Two foliar applications 14 d apart with a nonionic surfactant, preferably Capsil.
5a	Safari 20SG (dinotefuran) – Container drench	12.0 oz/100 gal	Single drench application using 4 fl oz solution per gallon of container pot volume Do not apply to saturated or dry soil
6a	Safari 20SG (dinotefuran) – Container drench	24.0 oz/100 gal	Do not leach pots for first week after application For transplanted plugs or liners: do not apply until new roots begin forming
5b	Safari 20SG (dinotefuran) – In-ground drench	3 g/ft of shrub or tree height	Single drench application to soil surface, at a volume of 1 qt of drench solution/foot of shrub or tree height. (Ex.: For a 4-ft shrub, dissolve 12 gm or 24 gm of Safari in 4 quarts of water and apply to soil surface.) Do not apply to saturated or dry soil Apply only when plants are actively growing.

6b	Safari 20SG (dinotefuran) – In-ground drench	6 g/ft of shrub or tree height	
7	Talus 40SC (buprofezin)	21.5 fl oz/100 gal	Two foliar applications 14 d apart
8	TriStar 30SG (acetamiprid)	112 g/100 gal	Two foliar applications 14 d apart with a non-ionic wetting agent.
9	TriStar 30SG (acetamiprid)	224 g/100 gal	Two foliar applications 14 d apart with a non-ionic wetting agent
10	Standard Foliar Treatment	Standard Rate	Two foliar applications 14 d apart
11	Untreated	--	--

For labels, materials, and any required adjuvants contact:

Flagship - Syngenta, Dave Ross, 336-632-6411, david.ross@syngenta.com

Safari - Valent, Joe Chamberlin, 770-985-0303, jcham@valent.com

Talus - SePRO, Todd Bunnell, 317-216-5667, toddb@sepro.com

Tristar - Cleary, Rick Fletcher, 732-329-8399, rick.fletcher@clearychemical.com

Reports:

Report must include a brief summary paragraph of results, a summary table with appropriate statistical analyses, a section on experimental design and materials and methods, with raw data and recordkeeping information as listed above included as appendices. If pictures were taken, please include them.

An electronic report is preferred but not required. If the report is provided electronically, the basic report can be sent in MS Word or WordPerfect, the recordkeeping information as pdf or other electronic documents, and the raw data in MS Excel or other suitable program such as ARM.

Please direct questions to: Cristi Palmer, IR-4 HQ, Rutgers University, 681 US Hwy 1 S, North Brunswick, NJ 08902-3390, Phone 732-932-9575 x629, palmer@aesop.rutgers.edu OR Ely Vea, 308 Aston Forest Lane, Crownsville, MD 21032, Phone & FAX#: 410-923-488, E-mail: evvea@comcast.net.

Revision Date: 1/05

Revised By: CLP

2005 Target Scale List

Pest Latin Name	Pest Common Name	Flagship	Safari	Talus	Tristar
<i>Aonidiella aurantii</i>	California Red Scale	Y	Y	N	Y
<i>Aspidiotus destructor</i>	Coconut Scale	Y	Y	Y	Y
<i>Aulacaspis yasumatsui</i>	Asian Cycad Scale	Y	N	Y	Y
<i>Ceroplastes ceriferus</i>	Indian Wax Scale	N	Y	N	Y
<i>Ceroplastes cirripediformis</i>	Barnacle Scale	N	Y	N	Y
<i>Ceroplastes floridensis</i>	Florida Wax Scale	Y	N	Y	Y
<i>Chionaspis pinifoliae</i>	Pine Needle Scale	Y	Y	Y	Y
<i>Chrysomphalus aonidum</i>	Florida Red Scale	Y	Y	N	Y
<i>Coccus hesperidum</i>	Brown Soft Scale	N	Y	N	Y
<i>Coccus pseudomagnoliarum</i>	Citricola Scale	N	Y	N	Y
<i>Diaspis boisduvali</i>	Boisduval Scale	Y	Y	N	Y
<i>Diaspis echinocacti</i>	Cactus Scale	Y	Y	N	Y
<i>Eucalymnatus tessellates</i>	Tessalated Scale	N	Y	N	Y
<i>Icerya purchasi</i>	Cottony Cushion Scale	N	Y	N	Y
<i>Lecanium fletcheri</i>	Fletcher Scale *	N	Y	Y	Y
<i>Lepidosaphes ulmi</i>	Oystershell Scale	Y	Y	N	Y
<i>Paratachardina lobata</i>	Lobate Lac Scale	Y	Y	Y	Y
<i>Pinnaaspis aspidistrae</i>	Fern Scale	Y	Y	N	Y
<i>Pseudaulacaspis cockerelli</i>	False Oleander Scale	N	Y	N	Y
<i>Pseudaulacaspis pentagona</i>	White Peach Scale	N	Y	N	Y
<i>Quadraspidotus perniciosus</i>	San Jose Scale	Y	Y	N	Y
<i>Saissetia coffeae</i>	Hemispherical Scale	N	Y	N	Y
<i>Saissetia oleae</i>	Black Scale	N	Y	N	Y
<i>Unaspis euonymi</i>	Euonymus Scale *	Y	Y	Y	Y
Scale insects not listed above		Y	Y	Y	Y

* Single trial conducted in 2004

Y = Researchable

N = No more data needed, but include as an additional standard in the trial

Blank = Unknown

Possible Protocols
(If you need help in setting up your protocol)

Mealybugs. Mealybugs are probably the easiest of this group on which to conduct efficacy trials. Methods may vary by host. The following protocol can be used for foliar attacking mealybugs:

Plants can be infested by placing a set number of mealybugs on each plant. Allow the insects to establish for at least two weeks prior to treatment. Weekly observations can be made by counting a set number of leaves each week or marking the terminals with a permanent marker and counting from the mark up to the tip of the terminal.

It is important to remember that you can have dead females under ovisac. Do not assume that a sac = live female. Crawlers will emerge from the ovisacs for a few weeks after the female has died. Don't be surprised to see crawlers emerging on a plant that you thought was clean.

- Casey, M. 2002. Control of mealybugs on coleus. <http://www.entsoc.org/Protected/AMT/AMT27/Text/G32.asp>
- Cloyd, R. 2003. Foliar applications and potting soil drenches of insecticides for control of citrus mealybug. www.entsoc.org/Protected/AMT/AMT28/Text/G22.asp
- Jacobsen, C. M. 2003. Control of coconut mealybug infesting fishtail palms with acetamiprid, chlorpyrifos, and thiamethoxam. www.entsoc.org/Protected/AMT/AMT28/Text/G29.asp

Soft Scales: Unlike mealybugs, soft scales can not be easily manipulated on the plant. It is best to find plant material already infested for the trials. The following protocol can be used for foliar or stem attacking soft scale:

It is best to wait until the majority of scales are late first or early second instars. To monitor the scale population, a set number of leaves or branches should be marked and the population followed over time. If the scale are all at the same stage at the start of the experiment it is easy to tell if the scale have died. Either they fall off the plant or they stop growing. It is usually easy to see the size difference between dead and growing scale. At the end of the experiment the branches or leaves can be removed from the plant and examined under a microscope or hand lens to confirm mortality.

- Hesselein, C.P. 1997. Control of Florida Was Scale on Dwarf Burford Holly. Proceedings of the SNA Research Conference. 42: 191-192.
- Hesselein, C.P. 2001. Evaluation of several insecticides for control of Florida Wax Scale. Proceedings of the SNA Research Conference. 46: 203-207.

Armored Scale: These are the most difficult group on which to conduct efficacy trials. These insects can not be easily manipulated on the plant and mortality is difficult to determine without the aid of a microscope. The following protocol can be used to determine armored scale mortality:

Remove a set number of leaves or stems and count the number of live and dead crawlers, nymphs, and adults with the aid of a dissecting microscope. Scale mortality can be determined by poking the scales with a dissecting pin and looking for bodily fluid or flipping the scale over and watching for leg and stylet movement (if present). It is common to observe the same number of scale from each plant and present the results as a percent mortality (use arcsine square root transformation to analyze the results).

- Jacobsen, C. 1999. Efficacy of Imidacloprid formulations against the green scale. Arthropod Management Tests. 24: 374-375.
- Smitley, D. 2002. Fletcher scale on Taxus. www.entsoc.org/Protected/AMT/AMT27/Text/G65.asp

**Efficacy of Aria 50SG, Flagship 25WP, Safari 20SG, Talus 40SC, and Tristar 20WSP
for Managing Mealybugs
04/19/05**

Ornamental Protocol Number: 05-002b

Objective: Determine efficacy of Aria, Flagship, Safari, Talus and Tristar on mealybug insects of ornamental plants.

Experimental Design:

Plot Size: Must be adequate to reflect actual use conditions.

Replicates: Minimum of 6, preferably 8-10 replications.

Application Instructions: For foliar applications, make two applications 14 days apart using a volume per acre suitable to provide adequate coverage of plant material. For drench applications of Safari 20SG, follow application guidelines in the table below conducting either 7a and 8a OR 7b and 8b based on whether plant material is in containers or in the ground. Applications should be made using application equipment consistent with conventional commercial equipment. Rates are in formulated product.

Target Species: See attached list of target species.

Plant Hosts: Use a plant host suitable for target mealybug species, recording species and variety used.

Use Site: May be greenhouse, field container or field in-ground. Please specify in final report.

Evaluations: Record initial insect counts and then 7, 14 (prior to 2nd application), 28 and 42 days after initial application. Record phytotoxicity at each rating date on a scale of 0 to 10 (0 = no phytotoxicity; 10 = complete kill). If phytotoxicity is observed in treated plants, take pictures comparing treated and untreated plant material.

Recordkeeping: Keep detailed records of weather conditions including temperature and precipitation, soil-type or soil-less media, application equipment, application volume per acre, irrigation, liner size, plant height & width, and plant growth stage at application and data collection dates.

Treatments:

#	Product	Rate	Application Instructions
1	Aria 50SG (flonicamid)	60 g/100 gal	Two foliar applications 14 d apart.
2	Aria 50SG (flonicamid)	120 g/100 gal	Two foliar applications 14 d apart
3	Flagship 25WP (thiamethoxam)	2.0 oz/100 gal	Two foliar applications 14 d apart. On hard to wet plants use a wetting agent, do not use surfactants/adjuvants that binds Flagship to the leaf surface.
4	Flagship 25WP (thiamethoxam)	4.0 oz/100 gal	Two foliar applications 14 d apart. On hard to wet plants use a wetting agent, do not use surfactants/adjuvants that binds Flagship to the leaf surface.
5	Safari 20SG (dinotefuran) – Foliar	4.0 oz/100 gal	Two foliar applications 14 d apart with a non-ionic surfactant, preferably Capsil.
6	Safari 20SG (dinotefuran) – Foliar	8.0 oz/100 gal	Two foliar applications 14 d apart with a non-ionic surfactant, preferably Capsil.
7a	Safari 20SG (dinotefuran) – Container drench	12.0 oz/100 gal	Single drench application using 4 fl oz solution per gallon of container pot volume Do not apply to saturated or dry soil
8a	Safari 20SG (dinotefuran) – Container drench	24.0 oz/100 gal	Do not leach pots for first week after application For transplanted plugs or liners: do not apply until new roots begin forming
7b	Safari 20SG (dinotefuran) – In-ground drench	3 g/ft of shrub or tree height	Single drench application to soil surface, at a volume of 1 qt of drench solution/foot of shrub or tree height.
8b	Safari 20SG (dinotefuran) – In-ground drench	6 g/ft of shrub or tree height	(Ex.: For a 4-ft shrub, dissolve 12 gm or 24 gm of Safari in 4 quarts of water and apply to soil surface.) Do not apply to saturated or dry soil. Apply only when plants are actively growing.

9	Talus 40SC (buprofezin)	18 fl oz/100 gal	Two foliar applications 14 d apart
10	TriStar 30SG (acetamiprid)	112 g/100 gal	Two foliar applications 14 d apart with a non-ionic wetting agent.
11	TriStar 30SG (acetamiprid)	224 g/100 gal	Two foliar applications 14 d apart with a non-ionic wetting agent.
12	Standard Foliar Treatment	Standard Rate	Two foliar applications 14 d apart
13	Untreated	--	--

For labels, materials, and any required adjuvants contact:

Aria - FMC, Bobby Walls, 919-735-3862, bobby_walls@fmc.com

Flagship - Syngenta, Dave Ross, 336-632-6411, david.ross@syngenta.com

Safari - Valent, Joe Chamberlin, 770-985-0303, jcham@valent.com

Talus - SePRO, Todd Bunnell, 317-216-5667, toddb@sepro.com

Tristar - Cleary, Rick Fletcher, 732-329-8399, rick.fletcher@clearychemical.com

Reports:

Report must include a brief summary paragraph of results, a summary table with appropriate statistical analyses, a section on experimental design and materials and methods, with raw data and recordkeeping information as listed above included as appendices. If pictures were taken, please include them.

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Please direct questions to: Cristi Palmer, IR-4 HQ, Rutgers University, 681 US Hwy 1 S, North Brunswick, NJ 08902-3390, Phone 732-932-9575 x629, palmer@aesop.rutgers.edu OR Ely Vea, 308 Aston Forest Lane, Crownsville, MD 21032, Phone & FAX#: 410-923-488, E-mail: evvea@comcast.net.

Revision Date: 1/05

Revised By: CLP

2005 Target Mealybug List

Pest Latin Name	Pest Common Name	Aria	Flagship	Safari	Talus	Tristar
<i>Pseudococcus maritimus</i>	Grape Mealybug	Y	Y	Y	N	Y
<i>Planococcus ficus</i>	Vine Mealybug	Y	Y	Y	N	Y
<i>Planococcus citri</i>	Citrus Mealybug	Y	Y	Y	N	Y
<i>Pseudococcus longispinus</i>	Long-tailed Mealybug	Y	Y	Y	N	Y
<i>Phenacoccus gossypii</i>	Mexican Mealybug	Y	Y	Y	N	Y
<i>Pseudococcus affinis</i>	Obscure Mealybug	Y	Y	Y	N	Y
<i>Maconellicoccus hirsutus</i>	Pink Hibiscus Mealybug	Y	Y	Y	Y	Y
<i>Phenacoccus madeirensis</i>	Madeira Mealybug	N	Y	Y	Y	Y
<i>Nipaecoccus nipae</i>	Coconut Mealybug	Y	Y	Y	Y	Y
Mealybugs not listed above		Y	Y	Y	Y	Y

Y = Researchable

N = No more data needed, but include as an additional standard in the trial

Blank = Unknown

Possible Protocols
(If you need help in setting up your protocol)

Mealybugs. Mealybugs are probably the easiest of this group on which to conduct efficacy trials. Methods may vary by host. The following protocol can be used for foliar attacking mealybugs:

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Appendix 2: Contributing Researchers

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Mr. Tom Freiberger	Rutgers University 283 Route 539 Cream Ridge, NJ 609-758-7311 x 19
Dr. Scott Ludwig	Texas Cooperative Extension P.O. Box 38 Overton, TX 75684 903-834-6191
Dr. Dave Nielsen	Ohio State University, OARDC Department of Entomology Wooster, OH 44691 330-263-3729
Dr. Ron Oetting	University of Georgia Department of Entomology Griffin, GA 30223 770-412-4714
Dr. Lance Osborne	University of Florida - IFAS
Dr. Dave Smitley & Terry Davis	Michigan State University Department of Entomology Michigan State University East Lansing, MI 48824-1115 517-353-9672

Appendix 3: Submitted Data Reports

The reports in this Appendix cover multiple PR numbers and are arranged alphabetically by mealybug or scale.

These reports can also be found at www.rutgers.ir4.edu by searching under the mealybug efficacy project and the scale efficacy project.