

Project Name: Borer & Beetle Efficacy

New		Ongoing	X	Completed			Duration if ongoing or completed:	2006–2013, 2016–2022
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Project Description:

Coleopteran borers and foliar feeding beetles present difficult to manage for distinct reasons. Borers are deposited as eggs on or just under bark. Once they hatch, they feed on trunks and branches with little visible sign of their presence until they pupate and emerge from the trees or shrubs as adults which then mate and start the cycle again. Many borer species have a single life cycle per year, but others may have multiple cycles and adult flights. The management challenge is how to best target the life cycle to minimize infestation when the most active and damaging life stage is hidden from view. Foliar feeding beetles present another challenge in that often the adults may be the most destructive feeding stage and may move away from the treated areas until the residues are too low to be effective.

Research Project Abstract (if available):

Abstract from 2022 Coleopteran Efficacy Summary

Collectively, managing coleopteran insects can be challenging because the adult and larval stages may both cause damage and sometimes occur on different hosts or on different plant parts. While organophosphates, pyrethroids, and neonicotinoids can provide good to excellent control of coleopteran insects, not all products work equally well in all situations. Treatments for borers are very different than treatments targeting white grubs. Developing newer classes of chemistry are important to reduce the environmental consequences and to minimize the development of resistance. Starting with the 2004 Annual Workshop, screening a number of products to manage coleopteran insects became one of the high priority projects for entomology. From 2005 through 2022, 91 products representing 58 different active ingredients were tested for management of adult and larval stages of coleopteran insects. In addition, 10 products representing 10 active ingredients were evaluated for lepidopteran clearwing borers in 2008 and 2009. These products represented both biological and chemical tools. Some products were already registered but more data were needed, or they were considered standards to measure the level of efficacy achieved with other materials. Other products were in development but have not yet been registered with the EPA. While a number of coleopteran and lepidopteran species were tested, only enough experiments were able to be completed on the coleopteran species black vine weevil, Japanese beetle, oriental beetle, red headed flea beetle, Sri Lankan weevil, and viburnum leaf beetles to recommend actions to register or amend labels for these pests.

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

Ambrosia Beetle (<i>Xylosandrus germanus</i>)	Flatheaded Apple Tree Borer (<i>Chrysobothris femorata</i>)
Ambrosia Beetle, Granulate/Asian (<i>Xylosandrus crassiusculus</i>)	Flea Beetle, Garden, Epitrix sp. (<i>Epitrix sp.</i>)
Ambrosia Beetle, Redbay (<i>Xyleborus glabratus</i>)	Japanese Beetle - adults (<i>Popillia japonica - adults</i>)
Banded Ash Clearwing Borer (<i>Podosesia aureocincta</i>)	Lilac Borer (<i>Podosesia syringa</i>)
Black Vine Weevil - adults (<i>Otiorhynchus sulcatus - adults</i>)	Peachtree Borer (<i>Synanthedon exitiosa</i>)
Bronze Birch Borer (<i>Agilus anxius</i>)	Red Headed Flea Beetle (<i>Systema frontalis</i>)
Emerald Ash Borer (<i>Agilus planipennis</i>)	Rednecked Cane Borer (<i>Agilus ruficollis</i>)
European Elm Flea Weevil (<i>Orchestes alni</i>)	Sri Lankan Weevil (<i>Myllocerus undatus</i>)
	Viburnum Leaf Beetle (<i>Pyrrhalta viburni</i>)

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

<i>Acer rubrum</i>	<i>Cornus florida</i>	<i>Fraxinus sp.</i>
<i>Albizia julibrissin</i>	<i>Cornus kousa</i>	<i>Hibiscus rosa-sinensis</i>
<i>Betula papyrifera</i>	<i>Eupatorium maculatum</i>	<i>Hibiscus syriacus</i>
<i>Betula pendula</i>	<i>Forsythia sp.</i>	<i>Hydrangea paniculata</i>
<i>Cercis canadensis</i>	<i>Fraxinus pennsylvanica</i>	<i>Hydrangea sp.</i>

Target Crops (con't)		
<i>Hylotelephium telephium</i>	<i>Prunus sp.</i>	<i>Syringa sp.</i>
<i>Itea virginica</i>	<i>Quercus sp.</i>	<i>Taxus X media</i>
<i>Lagerstroemia indica</i>	<i>Rhododendron sp.</i>	<i>Tilia cordata</i>
<i>Magnolia virginiana</i>	<i>Rosa sp.</i>	<i>Ulmus sp.</i>
<i>Oenothera sp.</i>	<i>Rubus sp.</i>	<i>Viburnum sp.</i>
<i>Persea borbonia</i>	<i>Salix sp.</i>	<i>Vitis sp.</i>
<i>Prunus sargentii</i>	<i>Salvia nemorosa</i>	

Target Product(s)(list tested products or numbered compounds if ongoing or completed project)	
Acelepryn (Chlorantraniliprole)	JMS Stylet Oil (Aliphatic petroleum distillate)
Acephate 97UP (Acephate)	KOC22018-8 (Botanical Oil Blend)
Acephate Pro 75 WSP (Acephate)	Kontos 240SC (Spirotetramat)
Admire PRO (imidacloprid)	Lorsban 4E (Chlorpyrifos)
Allectus SC (Bifenthrin + Imidacloprid)	Lynx EC 5.0 (Pyrethrins)
Aloft SC (Clothianadin + bifenthrin)	Mach 2 Liquid (Halofenazide)
Ammo EC (Cypermethrin)	Mainspring GNL 200SC (Cyantraniliprole)
Ancora (Isaria fumosorosea Apopka Strain 97 (ATCC 20874))	Marathon 1% granular (Imidacloprid)
Arbormectin (emamectin benzoate)	Marathon II (Imidacloprid)
Arena 50WDG (Clothianadin)	MBI 203 SC2 (MBI 203)
Asana XL (Esfenvalerate)	MBI-203 WDG (Chromobacterium subtsugae)
Astro (Permethrin)	Merit 2F (Imidacloprid)
Avaunt (indoxacarb)	Met52 (Metarhizium anisopliae strain F52)
AzaGuard (Azadirachtin)	NEI 25925 (Acetamiprid)
Azatin O (Azadirachtin)	Onyx (Bifenthrin)
Azatin XL (Azadirachtin)	Perm-Up 3.2EC (Permethrin)
BAS 320i (Metaflumizone)	Pradia (Cyclaniliprole + Flonicamid)
BCS-507 (BCS-507)	Precise Acephate (Acephate)
beetleGONE! tlc (Bacillus thuringiensis subsp. galleriae Strain SDS-502)	Pre-fe-ral (Biobest) (Paecilomyces fumosoroseus)
Benefit 60 WP (imidacloprid)	Preferal (SePro) (Isaria fumosoroseus)
Bifenthrin 8% ME (Bifenthrin)	Proclaim (Emamectin benzoate)
BotaniGard ES (BioWorks) (Beauveria bassiana Strain GHA)	Pyridium (Beta-cyfluthrin)
BotaniGard MAXX (Pyrethrins + Beauveria bassiana Strain GHA)	RTSA 721 (RTSA 721)
Bountify (MBI 306) (Burkholderia rinojensis strain A396)	RTSA-7650 (RTSA-7650)
BW133 (BW133)	Safari 20SG (Dinotefuran)
BW238 ES (BW238 ES)	Safari 2G (Dinotefuran)
BW238 WP (BW238 WP)	Sarisa 50SL (Cyclaniliprole)
Celero 16WVG (Clothianadin)	Scimitar CS (Lambda-cyhalothrin)
Conserve SC (Spinosad)	Sevin (zeta-cypermethrin - consumer label)
DEET (DEET)	Sevin SL (Carbaryl)
Discus (Imidacloprid + cyfluthrin)	SP3014 (SP3014)
DPX-HGW86 (Cyantraniliprole)	Talstar Flowable Insecticide/Miticide (Bifenthrin)
Dursban (Chlorpyrifos)	Talstar NF (Bifenthrin)
Entrust (Spinosad)	tbd (tbd)
Fanfare 2EC (bifenthrin)	Tempo 20WP (Cyfluthrin)
Flagship 0.22G (Thiamethoxam)	TetraCURB Concentrate (Rosemary Oil)
Flagship 25WG (Thiamethoxam)	TetraCURB Organic (Rosemary Oil)
Grandevo (MBI 203 DF) (Chromobacterium subtsugae NRRL B-30655)	Thiodan EC (Endosulfan)
Hachi-Hachi EC (Tolfenpyrad)	TickEx EC (Metarhizium anisopliae)
Hachi-Hachi SC (Tolfenpyrad)	Transtect (dinotefuran)
ISM-555 (ISM-555, A21377X)	TREE-age (emamectin benzoate)
	TriStar 30SG (Acetamiprid)
	TriStar 70WSP (Acetamiprid)
	TriStar 8.5SL (Acetamiprid)



Environmental Horticulture Program Research Project Sheet

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

Target Product(s)(con't)	
UP-Star Gold (Bifenthrin)	VST-006350 (Liquid) (GS-omega/kappa-Hxtx-Hv1a)
V-10433 (V-10433)	Xpectro OD (Pyrethrins + Beauveria bassiana Strain GHA)
Velifer (Beauveria bassiana Strain PPRI 5339)	Xxpire 40WG (Spinetoram + sulfoxaflor)
Venerate CG (Burkholderia rinojensis strain A396)	Xytect 2F (Imidacloprid)
VST 06330 EP (GS-omega/kappa-Hxtx-Hv1a)	Xytect 75WP (Imidacloprid)

Product Registration and Research Status			
	Fully Screened (also includes standards)	Partially Screened through IR-4 ¹	Need Data for Additional Species?
Labeled for Borers & Beetles Generally & Commercialized	Flagship 25WG Safari 20SG * Scimitar CS Talstar NF Tempo 20WP TriStar 30SG TriStar 70WSP	Acelepryn * Grandevo (MBI 203 DF) Hachi-Hachi * Met 52 EC (TickEx EC)* Sarisa (IKI-3106)	Allectus SC ² Aloft SC ² BeetleGONE Botanigard ES Botanigard MAXX Discus Marathon 1G Safari 2G Xpectro OD
Labeled Generally But NOT Commercialized			
Labeled for Specific Pests & Commercialized			
Labeled for Specific Pests but NOT Commercialized			
Not yet registered or labeled		Amaryllis ISM-555 Bountify (MBI-306) SP3014 V-10433 Venerate	
No longer available for development	Dursban 50W	BAS 320i Celero 16WSG ² Kontos *	
* 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			

PROS	CONS
Successful project for registrations	Several IRAC classes are available
Wide range of borers	Very few new tools for screening
Flat-headed borer & long-horn beetles	Wide range of borers and sites sometimes difficult to find or arrange, not enough infested trees to test
Good testing sites easy to find for bark and Ambrosia beetles	Ambrosia beetle – only pyrethroids
Need for thousand canker options (walnut twig borer)	Lep borers primarily landscape issues
New actives available (biological & chemical) for foliar feeding beetles	For some foliar feeding beetles, grubs are root feeders

Can be production limiting factor	Mesurool being phased out?
Ambrosia beetle is number 1 pest in parts of the US	
Wide range of economic impact based on system	
Japanese beetle: eradication efforts are still in progress in Oregon, but should it establish nurseries here are eager for products that won't disrupt current IPM programs should it establish.	
Potential new application method for chlorantraniliprole as a drench on Japanese Beetles	
Granular would be preferred for some	
Mediterranean Oak Beetle Efficacy project ongoing	
Comments: Sufficient data have been accumulated for registration decisions for Japanese Beetle and red headed flea beetle for all but Amaryllis in current protocol. Additional information needed for products in current protocol for coleopteran borers.	

IR-4 Efficacy Trials to Date
<p>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.</p> <p>'Labeled' indicates that this insect species or genera is listed on the label. A rating of 2 or lower is considered unacceptable efficacy (<i>red text</i>). 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.</p>

Table 1 of 3. Borers

MOA	Product (Active Ingredients)	Ambrosia Beetle (<i>Xylosandrus germanus</i>)	Ambrosia Beetle, Granulate/Asian (<i>Xylosandrus crassiusculus</i>)	Banded Ash Clearwing Borer (<i>Podosesia aureocincta</i>)	Emerald Ash Borer (<i>Agrilus planipennis</i>)
FRAC 7 / unknown	Rotation: ESP 715 / BCS-507 (Fluopyram / BCS-507)		1.0 (1 - 1) n1		
FRAC NC & IRAC UNF	Met52 (Metarhizium anisopliae strain F52)		1.0 (1 - 1) n1 Labeled		
IRAC 1B	Dursban (Chlorpyrifos)		1.0 (1 - 1) n2		
	Lorsban 4E (Chlorpyrifos)		2.5 (2 - 3) n2		
IRAC 21A	Hachi-Hachi EC (Tolfenpyrad)	3.0 (3 - 3) n1	1.0 (1 - 1) n1	5.0 (5 - 5) n1	
IRAC 22	Avaunt (indoxacarb)				
IRAC 22B	BAS 320i (Metaflumizone)		1.0 (1 - 1) n1		
IRAC 23	Kontos 240SC (Spirotetramat)		1.0 (1 - 1) n1		
IRAC 28	Acelepryn (Chlorantraniliprole)				
	Acelepryn (Dupont) (Chlorantraniliprole)	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n2 Labeled	5.0 (5 - 5) n1 Labeled	
	DPX-HGW86 (Cyantraniliprole)		1.0 (1 - 1) n1 Labeled		
	Mainspring GNL 200SC (Cyantraniliprole)				
IRAC 28 / IRAC 3A	Rotation: Mainspring / Scimitar (cyantraniliprole / lambda cyhalothrin)		2.0 (2 - 2) n1		
IRAC 28 + IRAC 3A	Tank Mix: Mainspring GNL + Scimitar GC (cyantraniliprole + lambda cyhalothrin)		3.0 (3 - 3) n1		
IRAC 2A	Thiodan EC (Endosulfan)		1.0 (1 - 1) n1		
IRAC 3	Fanfare 2EC (bifenthrin)				
IRAC 3A	Ammo EC (Cypermethrin)		1.5 (1 - 2) n2		
	Asana XL (Esfenvalerate)		2.0 (1 - 3) n3		
	Bifenthrin 8% ME (Bifenthrin)		4.0 (3 - 5) n2		
	Onyx (Bifenthrin)	3.0 (3 - 3) n1 Labeled	3.4 (1 - 5) n9 Labeled	2.0 (2 - 2) n1 Labeled	
	Perm-Up 3.2EC (Permethrin)		5.0 (5 - 5) n1		
	Scimitar CS (Lambda-cyhalothrin)	1.0 (1 - 1) n1 Labeled			
	Talstar NF (Bifenthrin)		3.0 (1 - 5) n3 Labeled		
IRAC 3A + unknown	Tank Mix: Onyx + Deet (Bifenthrin + DEET)		4.0 (4 - 4) n1		
	Tank Mix: Talstar L&T + DEET (Bifenthrin + DEET)		3.0 (3 - 3) n1		
	Tank Mix: Tempo 2 + DEET (Cyfluthrin + DEET)		3.0 (3 - 3) n1		

MOA	Product (Active Ingredients)	Ambrosia Beetle (<i>Xylosandrus germanus</i>)	Ambrosia Beetle, Granulate/Asian (<i>Xylosandrus crassiusculus</i>)	Banded Ash Clearwing Borer (<i>Podosesia aureocincta</i>)	Emerald Ash Borer (<i>Agrilus planipennis</i>)
IRAC 3A + IRAC 18B	Tank Mix: Onyx + Azatin XL (Bifenthrin + Neem Oil Extract)		3.0 (3 - 3) n1		
	Tank Mix: Onyx + Dursban (Bifenthrin + chlorpyrifos)		5.0 (5 - 5) n1		
IRAC 3A + IRAC 4A	Tank Mix: Onyx + Celero 16WSG (Bifenthrin + clothianadin)		5.0 (5 - 5) n1		
IRAC 3A + IRAC UNF	BotaniGard MAXX (Pyrethrins + Beauveria bassiana Strain GHA)		<i>1.0 (1 - 1) n1 Labeled</i>		
IRAC 4A	Admire PRO (imidacloprid)				
	Celero 16WSG (Clothianadin)		<i>1.5 (1 - 2) n2 Labeled</i>		
	Flagship 25WG (Thiamethoxam)	3.0 (3 - 3) n1	<i>1.0 (1 - 1) n1</i>		
	Merit 2F (Imidacloprid)				
	Safari 20SG (Dinotefuran)	<i>2.0 (1 - 3) n2 Labeled</i>	<i>1.0 (1 - 1) n1 Labeled</i>		
	Transtect (dinotefuran)				
	TriStar 30SG (Acetamiprid)			<i>1.0 (1 - 1) n1 Labeled</i>	
	Xytect 75WP (Imidacloprid)				<i>1.0 (1 - 1) n1</i>
IRAC 4A / unknown	Rotation: Marathon II / BCS-507 (Imidacloprid / BCS-507)		<i>1.0 (1 - 1) n1</i>		
IRAC 4A + IRAC 3	Aloft SC (Clothianadin + bifenthrin)			5.0 (5 - 5) n1 Labeled	
IRAC 4A + IRAC 3A	Discus (Imidacloprid + cyfluthrin)		<i>2.5 (2 - 3) n2 Labeled</i>		
IRAC 4A + unknown	Tank Mix: Discus + DEET (Imidacloprid + cyfluthrin + DEET)		4.0 (3 - 5) n2		
IRAC 5	Entrust (Spinosad) Conserve SC (Spinosad)				
IRAC UN	Azatin XL (Azadirachtin)		<i>1.0 (1 - 1) n1 Labeled</i>		
IRAC UNF	BotaniGard ES (BioWorks) (Beauveria bassiana Strain GHA)				
unknown	Arbormectin (emamectin benzoate)				4.0 (4 - 4) n1
	BCS-507 (BCS-507)		<i>1.0 (1 - 1) n1</i>		
	DEET (DEET)		4.0 (3 - 5) n2		
	JMS Stylet Oil (Aliphatic petroleum distillate)				

MOA	Product (Active Ingredients)	Ambrosia Beetle (<i>Xylosandrus germanus</i>)	Ambrosia Beetle, Granulate/Asian (<i>Xylosandrus crassiusculus</i>)	Banded Ash Clearwing Borer (<i>Podosesia aureocincta</i>)	Emerald Ash Borer (<i>Agrilus planipennis</i>)
	RTSA 721 (RTSA 721)				
	RTSA-7650 (RTSA-7650)				
	TREE-age (emamectin benzoate)				5.0 (5 - 5) n1
	V-10433 (V-10433)		1.0 (1 - 1) n1		

Table 2 of 3. Borers

MOA	Product (Active Ingredients)	Flatheaded Apple Tree Borer (<i>Chrysobothris femorata</i>)	Peachtree Borer (<i>Synanthedon exitiosa</i>)	Rednecked Cane Borer (<i>Agrilus ruficollis</i>)
FRAC 7 / Unknown	Rotation: ESP 715 / BCS-507 (Fluopyram / BCS-507)			
FRAC NC & IRAC UNF	Met52 (Metarhizium anisopliae strain F52)Ancora (Isaria fumosorosea Apopka Strain 97 (ATCC 20874))			
IRAC 1B	Dursban (Chlorpyrifos)			
	Lorsban 4E (Chlorpyrifos)			
IRAC 21A	Hachi-Hachi EC (Tolfenpyrad)		1.0 (1 - 1) n1	
IRAC 22	Avaunt (indoxacarb)			1.0 (1 - 1) n1
IRAC 22B	BAS 320i (Metaflumizone)			
IRAC 23	Kontos 240SC (Spirotetramat)			
IRAC 28	Acelepryn (Chlorantraniliprole)	5.0 (5 - 5) n1		
	Acelepryn (Dupont) (Chlorantraniliprole)		5.0 (5 - 5) n1 Labeled	
	DPX-HGW86 (Cyantraniliprole)		5.0 (5 - 5) n1 Labeled	
	Mainspring GNL 200SC (Cyantraniliprole)	3.0 (1 - 5) n2		
IRAC 28 / IRAC 3A	Rotation: Mainspring / Scimitar (cyantraniliprole / lambda cyhalothrin)			
IRAC 28 + IRAC 3A	Tank Mix: Mainspring GNL + Scimitar GC (cyantraniliprole + lambda cyhalothrin)			
IRAC 2A	Thiodan EC (Endosulfan)			
IRAC 3	Fanfare 2EC (bifenthrin)			1.0 (1 - 1) n1
IRAC 3A	Ammo EC (Cypermethrin)			
	Asana XL (Esfenvalerate)			
	Bifenthrin 8% ME (Bifenthrin)			
	Onyx (Bifenthrin)		5.0 (5 - 5) n1 Labeled	
	Perm-Up 3.2EC (Permethrin)			
	Scimitar CS (Lambda-cyhalothrin)		5.0 (5 - 5) n1 Labeled	
	Talstar NF (Bifenthrin)			
IRAC 3A + unknown	Tank Mix: Onyx + Deet (Bifenthrin + DEET)			
	Tank Mix: Talstar L&T + DEET (Bifenthrin + DEET)			
	Tank Mix: Tempo 2 + DEET (Cyfluthrin + DEET)			

MOA	Product (Active Ingredients)	Flatheaded Apple Tree Borer (<i>Chrysobothris femorata</i>)	Peachtree Borer (<i>Synanthedon exitiosa</i>)	Rednecked Cane Borer (<i>Agrilus ruficollis</i>)
IRAC 3A + IRAC 18B	Tank Mix: Onyx + Azatin XL (Bifenthrin + Neem Oil Extract)			
IRAC 3A + IRAC 1B	Tank Mix: Onyx + Dursban (Bifenthrin + chlorpyrifos)			
IRAC 3A + IRAC 4A	Tank Mix: Onyx + Celero 16WSG (Bifenthrin + clothianadin)			
IRAC 3A + IRAC UNF	BotaniGard MAXX (Pyrethrins + Beauveria bassiana Strain GHA)			
IRAC 4A	Admire PRO (imidacloprid)			3.0 (3 - 3) n1
	Celero 16WSG (Clothianadin)			
	Flagship 25WG (Thiamethoxam)	<i>1.0 (1 - 1) n2</i>	<i>1.0 (1 - 1) n1</i>	
	Merit 2F (Imidacloprid)	5.0 (5 - 5) n1		
	Safari 20SG (Dinotefuran)		5.0 (5 - 5) n1 Labeled	
	Transtect (dinotefuran)	5.0 (5 - 5) n1		
	TriStar 30SG (Acetamiprid)		5.0 (5 - 5) n1 Labeled	
	Xytect 75WP (Imidacloprid)			
IRAC 4A / Unknown	Rotation: Marathon II / BCS-507 (Imidacloprid / BCS-507)			
IRAC 4A + IRAC 3	Aloft SC (Clothianadin + bifenthrin)			
IRAC 4A + IRAC 3A	Discus (Imidacloprid + cyfluthrin)	<i>2.0 (2 - 2) n2 Labeled</i>	5.0 (5 - 5) n1 Labeled	
IRAC 4A + IRAC 3A + Unknown	Tank Mix: Discus + DEET (Imidacloprid + cyfluthrin + DEET)			
IRAC 5	Entrust (Spinosad)	<i>1.0 (1 - 1) n1</i>		
IRAC UN	Azatin XL (Azadirachtin)			
IRAC UNF	BotaniGard ES (BioWorks) (Beauveria bassiana Strain GHA)			<i>1.0 (1 - 1) n1</i>
unknown	Arbormectin (emamectin benzoate)			
	BCS-507 (BCS-507)			
	DEET (DEET)			
	JMS Stylet Oil (Aliphatic petroleum distillate)			<i>2.0 (2 - 2) n1</i>
	RTSA 721 (RTSA 721)	<i>1.0 (1 - 1) n1</i>		

MOA	Product (Active Ingredients)	Flatheaded Apple Tree Borer (<i>Chrysobothris femorata</i>)	Peachtree Borer (<i>Synanthedon exitiosa</i>)	Rednecked Cane Borer (<i>Agrilus ruficollis</i>)
	RTSA-7650 (RTSA-7650)	5.0 (5 - 5) n1		
	TREE-age (emamectin benzoate)			
	V-10433 (V-10433)			

Table 3 of 3 Foliar Feeding Coleopterans

MOA	Product (Active Ingredients)	Black Vine Weevil - adults (<i>Otiorhynchus sulcatus</i> - adults)	European Elm Flea Weevil (<i>Orchestes alni</i>)	Japanese Beetle - adults (<i>Popillia japonica</i> - adults)	Red Headed Flea Beetle (<i>Systema frontalis</i>)	Sri Lankan Weevil (<i>Myllocerus undatus</i>)	Viburnum Leaf Beetle (<i>Pyrrhalta viburni</i>)
FRAC BM02	Grandevo (MBI 203 DF) (Chromobacterium subtsugae NRRL B-30655)		1.0 (1 - 1) n1	1.0 (1 - 1) n1	1.7 (1 - 3) n6		
FRAC BM02	MBI-203 WDG (Chromobacterium subtsugae)					3.0 (3 - 3) n1	
FRAC BM02 & IRAC UNB	Venerate CG (Burkholderia rinojensis strain A396)					2.0 (2 - 2) n1	
FRAC NC	BW133 (BW133)			1.0 (1 - 1) n2	3.0 (3 - 3) n1		
FRAC NC & IRAC UNB	Bountify (MBI 306) (Burkholderia rinojensis strain A396)			1.4 (1 - 2) n5	1.0 (1 - 1) n4		
FRAC NC & IRAC UNF	Ancora (Isaria fumosorosea Apopka Strain 97 (ATCC 20874))				2.0 (1 - 3) n2		
	Met52 (Metarhizium anisopliae strain F52)	1.0 (1 - 1) n1 Labeled					1.0 (1 - 1) n2 Labeled
	Pre-fe-ral (Biobest) (Paecilomyces fumosoroseus)				1.0 (1 - 1) n1		
	Preferal (SePro) (Isaria fumosoroseus)				1.4 (1 - 3) n5	2.0 (2 - 2) n1	
IRAC 11A	beetleGONE! tlc (Bacillus thuringiensis subsp. galleriae Strain SDS-502)				1.3 (1 - 2) n6	2.0 (2 - 2) n1	
IRAC 1A	Sevin SL (Carbaryl)			5.0 (5 - 5) n2			
IRAC 1B	Acephate 97UP (Acephate)				1.0 (1 - 1) n1		
	Acephate Pro 75 WSP (Acephate)				1.0 (1 - 1) n1		
	Precise Acephate (Acephate)			2.0 (2 - 2) n1 Labeled			
IRAC 21A	Hachi-Hachi EC (Tolfenpyrad)	1.0 (1 - 1) n1	1.0 (1 - 1) n1	1.5 (1 - 3) n4	1.7 (1 - 3) n3		3.0 (3 - 3) n2
	Hachi-Hachi SC (Tolfenpyrad)				2.2 (1 - 5) n12 Labeled	2.0 (2 - 2) n1 Labeled	
IRAC 22B	BAS 320i (Metaflumizone)	5.0 (5 - 5) n1		2.8 (1 - 5) n5			3.0 (3 - 3) n2
IRAC 28	Acelepryn (Chlorantraniliprole)			4.7 (4 - 5) n3	1.0 (1 - 1) n4		
	Acelepryn (Dupont) (Chlorantraniliprole)	1.0 (1 - 1) n1 Labeled		3.6 (1 - 5) n9 Labeled			4.0 (3 - 5) n7 Labeled

MOA	Product (Active Ingredients)	Black Vine Weevil - adults (<i>Otiorhynchus sulcatus</i> - adults)	European Elm Flea Weevil (<i>Orchestes alni</i>)	Japanese Beetle - adults (<i>Popillia japonica</i> - adults)	Red Headed Flea Beetle (<i>Systema frontalis</i>)	Sri Lankan Weevil (<i>Myloccerus undatus</i>)	Viburnum Leaf Beetle (<i>Pyrrhalta viburni</i>)
	Mainspring GNL 200SC (Cyantraniliprole)				2.4 (1 - 5) n7		
	Sarisa 50SL (Cyclaniliprole)			4.6 (4 - 5) n5 Labeled	3.1 (1 - 5) n9 Labeled	2.0 (2 - 2) n1 Labeled	
IRAC 28 +	Tank Mix: Sarissa + Azatin O (Cyclaniliprole + azadirachtin)				3.0 (3 - 3) n1		
IRAC 28 + IRAC 29	Pradia (Cyclaniliprole + Flonicamid)				2.0 (2 - 2) n1		
IRAC 32	VST-006350 (Liquid) (GS-omega/kappa-Hxtx-Hv1a)			1.0 (1 - 1) n1	1.0 (1 - 1) n4		
IRAC 3A	Lynx EC 5.0 (Pyrethrins)					1.0 (1 - 1) n1	
	Onyx (Bifenthrin)			4.7 (3 - 5) n7 Labeled	1.0 (1 - 1) n2 Labeled		
	Pyridium (Beta-cyfluthrin)			4.0 (4 - 4) n1	5.0 (5 - 5) n1		
	Scimitar CS (Lambda-cyhalothrin)			4.0 (3 - 5) n2 Labeled	3.0 (1 - 5) n5 Labeled		
	Talstar Flowable Insecticide/Miticide (Bifenthrin)			5.0 (5 - 5) n2 Labeled			
	Talstar NF (Bifenthrin)	5.0 (5 - 5) n1 Labeled					
	UP-Star Gold (Bifenthrin)				3.0 (3 - 3) n1		
IRAC 3A + IRAC UNF	BotaniGard MAXX (Pyrethrins + Beauveria bassiana Strain GHA)			1.0 (1 - 1) n2 Labeled	1.0 (1 - 1) n2 Labeled		
IRAC 3A + IRAC UNF	Xpectro OD (Pyrethrins + Beauveria bassiana Strain GHA)			2.0 (1 - 3) n2		1.0 (1 - 1) n1	
IRAC 4A	Benefit 60 WP (imidacloprid)				1.0 (1 - 1) n1		
	Celero 16WSG (Clothianadin)	1.0 (1 - 1) n1 Labeled		2.4 (1 - 5) n8 Labeled			3.3 (3 - 4) n3 Labeled
	Flagship 0.22G (Thiamethoxam)				1.0 (1 - 1) n1		
	Flagship 25WG (Thiamethoxam)			2.5 (2 - 3) n2	3.5 (3 - 4) n2		4.3 (4 - 5) n4
	Marathon 1% granular (Imidacloprid)				3.0 (3 - 3) n2 Labeled		
	Marathon II (Imidacloprid)			5.0 (5 - 5) n1	3.0 (3 - 3) n1		
	Merit 2F (Imidacloprid)						

MOA	Product (Active Ingredients)	Black Vine Weevil - adults (<i>Otiorhynchus sulcatus</i> - adults)	European Elm Flea Weevil (<i>Orchestes alni</i>)	Japanese Beetle - adults (<i>Popillia japonica</i> - adults)	Red Headed Flea Beetle (<i>Systema frontalis</i>)	Sri Lankan Weevil (<i>Myloccerus undatus</i>)	Viburnum Leaf Beetle (<i>Pyrrhalta viburni</i>)
	Safari 20SG (Dinotefuran)	1.0 (1 - 1) n1 <i>Labeled</i>	2.0 (2 - 2) n1 <i>Labeled</i>	2.3 (1 - 5) n9 <i>Labeled</i>	2.6 (1 - 5) n13 <i>Labeled</i>		3.0 (2 - 4) n3 Labeled
	Safari 2G (Dinotefuran)			4.0 (3 - 5) n2 Labeled			1.0 (1 - 1) n1 <i>Labeled</i>
	Transtect (dinotefuran)						
	TriStar 30SG (Acetamiprid)			5.0 (5 - 5) n1 Labeled	2.0 (1 - 3) n3 <i>Labeled</i>		4.0 (4 - 4) n1 Labeled
	TriStar 70WSP (Acetamiprid)			3.3 (1 - 5) n4 Labeled			
	TriStar 8.5SL (Acetamiprid)			5.0 (5 - 5) n1	4.8 (4 - 5) n4 Labeled		
	Xytect 2F (Imidacloprid)		3.0 (3 - 3) n1	1.0 (1 - 1) n1			
	Xytect 75WP (Imidacloprid)						
IRAC 4A / unknown	Rotation: Marathon II / BCS-507 (Imidacloprid / BCS-507)						
IRAC 4A + IRAC 3	Aloft SC (Clothianadin + bifenthrin)		2.0 (2 - 2) n1 <i>Labeled</i>	3.0 (1 - 5) n2 Labeled	4.0 (4 - 4) n3 Labeled		
IRAC 4A + IRAC 3A	Discus (Imidacloprid + cyfluthrin)				4.0 (4 - 4) n1 Labeled		
IRAC 5	Conserve SC (Spinosad)						4.3 (3 - 5) n4 Labeled
IRAC 5 + IRAC 4C	Xxpire 40WG (Spinetoram + sulfoxaflor)				2.6 (1 - 5) n7 <i>Labeled</i>		
IRAC UN	AzaGuard (Azadirachtin)			1.0 (1 - 1) n1		1.0 (1 - 1) n1	
IRAC UN	Azatin O (Azadiractin)				1.0 (1 - 1) n1		
IRAC UNE	TetraCURB Concentrate (Rosemary Oil)			1.0 (1 - 1) n1	2.5 (2 - 3) n2		
	TetraCURB Organic (Rosemary Oil)			1.0 (1 - 1) n1	1.0 (1 - 1) n1		
IRAC UNF	BotaniGard ES (BioWorks) (Beauveria bassiana Strain GHA)			1.3 (1 - 2) n3		2.0 (2 - 2) n1	
	TickEx EC (Metarhizium anisopliae)			1.0 (1 - 1) n5			
	Velifer (Beauveria bassiana Strain PPRI 5339)			2.0 (2 - 2) n1 <i>Labeled</i>	1.5 (1 - 2) n2 <i>Labeled</i>		
unknown	BCS-507 (BCS-507)			5.0 (5 - 5) n1	5.0 (5 - 5) n2		

MOA	Product (Active Ingredients)	Black Vine Weevil - adults (<i>Otiorhynchus sulcatus</i> - adults)	European Elm Flea Weevil (<i>Orchestes alni</i>)	Japanese Beetle - adults (<i>Popillia japonica</i> - adults)	Red Headed Flea Beetle (<i>Systema frontalis</i>)	Sri Lankan Weevil (<i>Myllocerus undatus</i>)	Viburnum Leaf Beetle (<i>Pyrrhalta viburni</i>)
	BW238 ES (BW238 ES)			1.0 (1 - 1) n2	3.0 (3 - 3) n1		
	BW238 WP (BW238 WP)			1.0 (1 - 1) n2			
	ISM-555 (ISM-555, A21377X)			4.0 (3 - 5) n5	4.0 (3 - 5) n4		
	KOC22018-8 (Botanical Oil Blend)			1.0 (1 - 1) n1	2.5 (1 - 4) n2		
	MBI 203 SC2 (MBI 203)			1.4 (1 - 3) n5	1.0 (1 - 1) n4		
	RTSA 721 (RTSA 721)			2.2 (1 - 5) n12			
	Sevin (zeta-cypermethrin - consumer label) (zeta-cypermethrin)			5.0 (5 - 5) n1			
	SP3014 (SP3014)			1.2 (1 - 2) n5	1.5 (1 - 3) n4		
	V-10433 (V-10433)			1.4 (1 - 3) n7	1.6 (1 - 3) n5		