Project Name: Borer & Beetle Efficacy

New		Ongoing		Completed	X	Duration if ongoing or completed:	2006 - 2013

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, the 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 2010 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 2009, 51 products representing 34 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 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 (granulate) (*Xylosandrus crassiusculus*)	Japanese Beetle - adults (*Popillia japonica*)
Ambrosia Beetle (*Xylosandrus germanus*)	Peachtree Borer (*Synanthedon exitiosa*)
Banded Ash Clearwing Borer (*Podosesia aureocincta*)	Red Headed Flea Beetle (*Systena frontalis*)
Black Vine Weevil - adults (*Otiorhynchus sulcatus*)	Viburnum leaf beetle (*Pyrrhalta viburni*)

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

Arrowwood (*Viburnum dentatum*)	Evening Primrose, Sundrops (*Oenothera sp.*)	Red Bud, Eastern (*Cercis canadensis*)
Ash (*Fraxinus pennsylvanica*)	Grape (Non-Bearing) (*Vitis sp.*)	Redbay (*Persea borbonia*)
Birch, Paper (*Betula papyrifera*)	*Hydrangea sp*.	Rhododendron (*Rhododendron sp.*)
Caneberry (Non-Bearing) (*Rubus idaeus*)	Joepye weed, Spotted (*Eupatorium maculatum*)	Rose (*Rosa sp.*)
Cherry (Non-Bearing) (*Prunus cistina*)	Lilac (*Syringa sp.*)	Rose-Of-Sharon, Althaea (*Hibiscus syriacus*)
Cherry, Sargent (*Prunus sargentii*)	Linden, Shamrock (*Tilia cordata*)	Sweet Bay (*Magnolia virginiana*)
Dogwood, Kousa (*Cornus kousa*)	Maple, Red (*Acer rubrum*)	Virginia Sweetspire (*Itea virginica*)
European White Birch (*Betula pendula*)	Mimosa Silk Tree (*Albizia julibrissin*)	Willow (*Salix sp.*)
	Oak (*Quercus sp.*)	Yew (*Taxus media*)

Target Product(s) (list tested products or numbered compounds if ongoing or completed project)				
Acelepryn	Azatin XL	Dursban 50W	Met52	Scimitar CS
Allectus SC	BAS 320i	Flagship 25WG	NEI 25925	Talstar NF
Aloft SC	Bifenthrin 8% ME	Grandevo	Onyx	Tempo 20WP
Ammo EC	Celero 16WSG	Hachi-Hachi	Perm-Up 3.2ECl	Thiodan EC
Arena 50WDG	DEET	Kontos	Proclaim	TickEx EC
Asana XL	Discus	Lorsban 4E	Safari 20SG	TriStar 30SG
Astro	DPX-HGW86	Marathon 1G	Safari 2G	TriStar 70WSP

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	Grandevo (MBI 203 DF) **Hachi-Hachi *** **Met 52 EC (TickEx EC)***	Allectus SC [2] Aloft SC [2] Discus Marathon 1G Safari 2G
Labeled Generally But NOT Commercialized			
Labeled for Specific Pests & Commercialized			
Labeled for Specific Pests but NOT Commercialized			
Not yet registered or labeled			
No longer available for development	DPX-HGW86 Dursban 50W	**Acelepryn *** **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

Project Pros	Project Cons
1 Successful project for registrations	1 Several IRAC classes are available
2 Wide range of borers	2 Very few new tools for screening
3 Can be production limiting factor	3 Wide range of borers and sites sometimes difficult to find or arrange
4 Flat-headed borer & long-horned beetles	
5 Wide range of economic impact based on system	

IR-4 Efficacy Trials to Date

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

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

Product (Active Ingredients)	Ambrosia Beetle (granulate) (*Xylosandrus crassiusculus*)	Ambrosia Beetle (*Xylosandrus germanus*)	Banded Ash Clearwing Borer (*Podosesia aureocincta*)	Black Vine Weevil - adults (*Otiorhynchus sulcatus*)	Japanese Beetle - adults (*Popillia japonica*)	Red Headed Flea Beetle (*Systena frontalis*)	Viburnum leaf beetle (*Pyrrhalta viburni*)	Peachtree Borer (*Synanthedon exitiosa*)
Acelepryn (aka DPX-E2Y45) 1.67 (Chlorantraniliprole)	*1.0 (1 - 1) n1*	*1.0 (1 - 1) n1*	5.0 (5 - 5) n1 Labeled	*1.0 (1 - 1) n1*	**3.9 (1 - 5) n8**		**3.5 (3 - 4) n2**	**5.0 (5 - 5) n1**
Aloft SC (Clothianadin + bifenthrin)			**5.0 (5 - 5) n1**			4.0 (4 - 4) n2 Labeled		
Azatin XL (Azadirachtin)	*1.0 (1 - 1) n1 Labeled*							
BAS 320i (Metaflumizone)	*1.0 (1 - 1) n1*			**5.0 (5 - 5) n1**	*2.3 (1 - 5) n4*		**3.0 (3 - 3) n1**	
Celero 16WSG (Clothianidin)				*1.0 (1 - 1) n1*	*2.2 (1 - 5) n6 Labeled*		**3.5 (3 - 4) n2**	
DEET	**3.0 (1 - 5) n3**							
Discus (Imidacloprid + cyfluthrin)	*2.0 (1 - 4) n3*							5.0 (5 - 5) n1 Labeled
DPX-HGW86 (Cyantraniliprole)								**5.0 (5 - 5) n1**
Flagship 0.22G (Thiamethoxam)						*1.0 (1 - 1) n1*		
Flagship 25WG (Thiamethoxam)	*1.0 (1 - 1) n1*	**3.0 (3 - 3) n1**			*2.5 (2 - 3) n2*	**4.0 (4 - 4) n1**		*1.0 (1 - 1) n1*
Grandevo (MBI 203 DF) (Chromobacterium subtsugae NRRL B-30655)						*1.5 (1 - 2) n2*		
Hachi-Hachi (Tolfenpyrad)	*1.0 (1 - 1) n1*	**3.0 (3 - 3) n1**	**5.0 (5 - 5) n1**	*1.0 (1 - 1) n1*	*1.0 (1 - 1) n2*	*2.0 (1 - 3) n2*	**3.0 (3 - 3) n1**	*1.0 (1 - 1) n1*
Kontos (BYI 8330 240SC) (Spirotetramat)	*1.0 (1 - 1) n1*							
Marathon 1% granular (Imidacloprid)						3.0 (3 - 3) n2 Labeled		
Met52 (Metarhizium anisopliae strain F52)	*1.0 (1 - 1) n1*			*1.0 (1 - 1) n1 Labeled*			*1.0 (1 - 1) n1*	
Onyx (Bifenthrin)	3.7 (3 - 4) n3 Labeled	3.0 (3 - 3) n1 Labeled	*2.0 (2 - 2) n1 Labeled*		4.6 (3 - 5) n5 Labeled	*1.0 (1 - 1) n1 Labeled*		5.0 (5 - 5) n1 Labeled
Precise Acephate (Acephate)					*2.0 (2 - 2) n1 Labeled*			
Safari 20SG (Dinotefuran)	*1.0 (1 - 1) n1*	*2.0 (1 - 3) n2*		*1.0 (1 - 1) n1*	*2.1 (1 - 4) n7 Labeled*	**3.5 (2 - 5) n2**	3.5 (3 - 4) n2 Labeled	5.0 (5 - 5) n1 Labeled
Safari 2G (V-10112 2G) (Dinotefuran)					**4.0 (3 - 5) n2**		*1.0 (1 - 1) n1*	
Scimitar CS (Lambda-cyhalothrin)		*1.0 (1 - 1) n1*			4.0 (3 - 5) n2 Labeled			**5.0 (5 - 5) n1**

Product (Active Ingredients)	Ambrosia Beetle (granulate) (*Xylosandrus crassiusculus*)	Ambrosia Beetle (*Xylosandrus germanus*)	Banded Ash Clearwing Borer (*Podosesia aureocincta*)	Black Vine Weevil - adults (*Otiorhynchus sulcatus*)	Japanese Beetle - adults (*Popillia japonica*)	Red Headed Flea Beetle (*Systena frontalis*)	Viburnum leaf beetle (*Pyrrhalta viburni*)	Peachtree Borer (*Synanthedon exitiosa*)
Talstar Flowable Insecticide/Miticide (Bifenthrin)					5.0 (5 - 5) n1 Labeled			
Talstar NF (Bifenthrin)				5.0 (5 - 5) n1 Labeled				
Tank Mix: Discus + DEET (Imidacloprid + cyfluthrin + DEET)	**5.0 (5 - 5) n3**							
Tempo 20WP (Cyfluthrin)	*1.0 (1 - 1) n2*							
TickEx EC (Metarhizium anisophliae)					*1.0 (1 - 1) n5*			
TriStar 30SG (Acetamiprid)			*1.0 (1 - 1) n1*		5.0 (5 - 5) n1 Labeled	*1.5 (1 - 2) n2*	4.0 (4 - 4) n1 Labeled	**5.0 (5 - 5) n1**
TriStar 70WSP (Acetamiprid)					3.3 (1 - 5) n4 Labeled			

Registered and Experimental Products for Borer & Beetle Management

Foliar or Trunk Applied Insecticides (active ingredients)	IRAC Class	Registered Use Site(s)	Knock Down	Residual Control (days)	REI	Borer Efficacy					Foliar Feeding Beetle Efficacy				
						Ambrosia Beetles	Banded Ash Clearwing Borer	Bronze Birch Borer	Flat-headed Appletree Borer	Peachtree Borer	Black Vine Weevil Adults	Japanese Beetle Adults	Redheaded Flea Beetle Adults	Viburnum Leaf Beetle Larvae	European Elm Flea Weevil
Asana (esfenvalerate)	3A	N	F	7-10	12 h	P-F	?	?	?	?	?	?	?	?	?
Astro, Permethrin.Pro, etc. (permethrin)	3A	G, I	F	5-7	12 h	?	?	?	?	?	?	?	?	F-G	?
Azatin Molt-X, etc. (azadirachtin)	18B	G, I, N, S	S	7	4 h	P	?	?	?	?	?	?	?	?	?
BotaniGard, Naturalis L (*Beauveria bassiana*)	M	G, I, N, S	M	2-5	4 h	?	?	?	?	?	?	?	?	?	?
Cinnacure (cinnamaldehyde)	-	G, N	F	?	4 h	?	?	?	?	?	?	?	?	?	?
Conserve SC, Entrust (spinosad)	5	G, L, N, S	F	5	4 h	?	?	?	?	?	?	?	?	P-E	?
Cygon, Dimethoate (dimethoate)	1B	N	F	5-7?	48 h	?	?	?	?	?	?	?	?	?	?
Decathlon, Tempo (cyfluthrin)	3A	G, I, N	F	7	12 h	P	?	?	?	?	?	?	?	?	?
Deliver, etc. (*Bacillus thuringiensis* subsp. *kurstaki*)	11A	G, N	S	?	4 h	?	?	?	?	?	?	?	?	?	?
Discus Tablet (cyfluthrin+imidacloprid)	3A + 4A	N	F	5-7	12 h	P	?	?	P**	E**	?	?	?	?	?
Duraguard, Dursban (chlorpyrifos)	1B	G, N	F	5-7	24 h	P-F	?	?	?	?	?	?	?	?	?
Ecotec, Ecotrol (rosemary and peppermint oils)	-	G, N	?	5-7	0 h	?	?	?	?	?	?	?	?	?	?
Flagship 25WG (thiamethoxam)	4A	G, L, N, S	F	7-14	12 h	P-F**	?	G	P**	F***	?	P-G	P-E	F-E	?
Grandevo, MBI-203 DF (*Chromobacteriumsubtsugae* strain PRAA4-1^{T})	-	G, N	S	?	4 h	?	?	?	?	?	?	P	P	?	P
Imidan (phosmet)	1B	N	F	?	24 h or 13 d	?	?	?	?	?	?	?	?	?	?
Kryocide (cryolite)	UN	N	?	?	12 h	?	?	?	?	?	?	?	?	?	?
Mainspring, A20520A, DPX-HGW86 (cyantraniliprole)	28	G, I	F	?	4 h	P	?	?	?	E**	?	?	?	?	?
Malathion	1B	G, N	F	5-7	12 h	?	?	?	?	?	?	?	?	?	?
Marathon (imidacloprid)	4A	G, I, N	F	?	12 h	?	?	?	?	?	?	?	F*	G*	G**
Mavrik (fluvalinate)	3A	G, I, N	F	14	12 h	?	?	?	?	?	?	?	?	?	?
M-Pede, Safer Soap, etc. (potassium salts of fatty acids)	-	G, I, N	F	Contact	12 h	?	?	?	?	?	?	?	?	?	?
NoFly WP (*Paecilomyces fumosoroseus* strain FE 9901)	-	G	M	3-7	4 h	?	?	?	?	?	?	?	?	?	?
Onyx, Talstar, etc. (bifenthrin)	3A	G, I, N	F	7	12 h	P-E	P	?	?	E	E	E	P	?	?
Orthene T&O, Precise, etc. (acephate)	1B	G, N	F	7	24 h	?	?	?	?	?	?	P	?	?	?

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

Registered and Experimental Products for Borer & Beetle Management

Foliar or Trunk Applied Insecticides (active ingredients)	IRAC Class	Registered Use Site(s)	Knock Down	Residual Control (days)	REI	Borer Efficacy					Foliar Feeding Beetle Efficacy				
						Ambrosia Beetles	Banded Ash Clearwing Borer	Bronze Birch Borer	Flat-headed Appletree Borer	Peachtree Borer	Black Vine Weevil Adults	Japanese Beetle Adults	Redheaded Flea Beetle Adults	Viburnum Leaf Beetle Larvae	European Elm Flea Weevil
PrentoxPyronyl Crop Spray, Pyrenone Crop Spray, etc. (pyrethrins + PBO)	3A + -	G, N	F	Contact	12 h	?	?	?	?	?	?	?	?	?	?
Safari 20SG (dinotefuran)	4A	G, N	M	7	12 h	P, P**	?	?	?	E**	P	P-G	E	G-E	P**
Scimitar GC (lambda-cyhalothrin)	3A	G, N, S	F	7	24 h	?	?	?	?	E	?	G	F-G	?	?
Sevin (carbaryl)	1A	N	F	7	12 h	?	?	?	?	?	?	?	?	?	?
Surround WP (kaolin)	-	G	?	Contact	4 h	?	?	?	?	?	?	?	?	?	?
Tame (fenpropathrin)	3A	G, I, L, N, S	F	7	24 h	?	?	?	?	?	?	?	?	?	?
Thiodan (endosulfan)	2A	G, N	F	10	24 h	P	?	?	?	?	?	?	?	?	?
TriStar (acetamiprid)	4A	G, L, N, S	F	?	12 h	?	P	G	?	E	?	F-E	P	G	?
Ultra pure oil, SuffOil-X, etc. (paraffinic oil)	-	G, N	F	Contact	4 h	?	?	?	?	?	?	?	?	?	?
XXpire (spinoteram+sulfoxaflor)	5+4C	G, N	F	14	12 h	?	?	?	?	?	?	?	P	?	?
Experimental Products															
Acelepryn/DPX-E2Y45 (chlorantraniliprole)	28	TBD	F	?	4 h	P	E	?	?	E**	P	G-E	?	F-E	?
Allectus (bifenthrin + imidacloprid) [a]	3A + 4A	TBD	F	?	12 h	?	?	?	?	?	?	?	?	?	?
Aloft (bifenthrin + clothianidin)	3A + 4A	TBD	F	?	12 h	?	E	?	?	?	?	P-E	F-G	?	P
Arena, Celero (clothianidin)	4A	TBD	F	?	12 h	P	?	?	?	?	P			F-E	?
BAS 320i (metaflumizone)	22B	TBD	?	?	?	P	?	?	?	?	E	P-E	?	G-E	?
Hachi-Hachi EC (tolfenpyrad)	21A	G	F	7-14	12 h	P-F	E	?	?	P	P	P-E	E	F-G	P
IKI-3106 (cyclaniliprole)	-	TBD	?	?	?	?	?	?	?	?	?	?	?	?	?
Kontos, BYI-8330 (spirotetramat)	23	G, I, N	S	7-14	24 h	?	?	?	?	?	?	?	?	?	?
Met 52, Tick Ex (*Metarhizium anisopliae* F52)	-	G, N	M	5-7	4 h	P	?	?	?	?	P	P-E	?	P	?
UPI 301 (imidacloprid + acephate)	1B + 4A	TBD	F	?	?	?	?	?	?	?	?	?	?	?	?

Registered Use Sites: G = Greenhouse; L = Lath House; I = Indoors; N = Nursery; S = Shade House; TBD = To Be Determined
Knockdown: Fast (< 1 day), Medium (1-7 days), Slow (>7 days).
Efficacy: P = Poor (< 70% control); F = Fair (70% to 85% control); G = Good (85% to 95% control), E = Excellent (>95% control) on immatures and/or adults 1 to 3 weeks after first app.

Residual Control taken from product technical and label information recommendations on earliest application intervals; Efficacy taken from latest IR-4 efficacy summary draft; no trials found in AMT; Only one insect biological control agent for borers and leaf feeding beetles, *Harmonia axyridis*, listed in Koppert and Biobest websites.

* Soil treatment
** Drench treatment
*** Top-dress treatment
[a] No longer available for testing

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