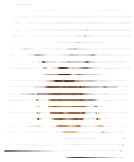
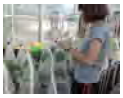
2.2.1 Evaluate efficacy of registered and developmental insecticides against BMSB

Peter Jentsch, Greg Krawczyk,
Tom Kuchar, Tracy Leskey, Silvia Rondon and Jim Walgenbach



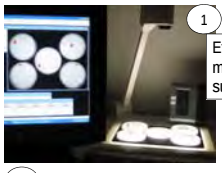


Most effective insecticides against BMSB

(based on combined data from T. Leskey, T. Kuchar and G. Krawczyk)

PYRETHROIDS (IRAC Group 3A)	NEONICOTINOIDS (IRAC Group 4A)	OTHER (IRAC Groups 1A, 1B, 2A)
bifenthrin (Brigade)	dinotefuran (Venom, Scorpion)	methomyl (carbamate) (Lannate LV and SP)
fenpropathrin (Danitol)	thiametoxam (Actara)	endosulfan (organochlorine) (Thionex)
cyfluthrin (Baythroid)	clothianidin (Belay)	acephate (organophosphate) (Acephate)
λ-cyhalothrin (Warrior)	imidacloprid (Provado, Admire Pro)	
	acetamiprid (Assail)	

Experimental Trials – organic insecticides



1. EthoVision trials for measuring horizontal mobility of adults on insecticide-treated surfaces.

2. Direct observations of vertical movement capacity following insecticide exposure.

3. Mortality tracked for 7-d followed by final vertical movement trial.

USDA ARS

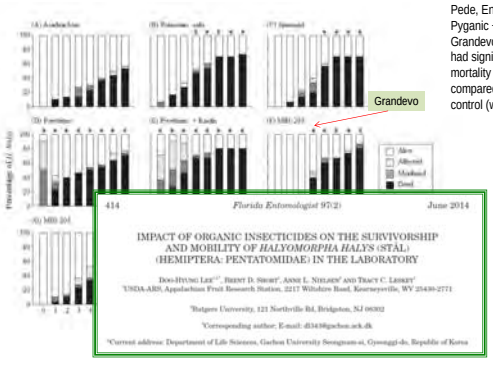
Targeted Materials

Trade Name	Active Ingredient	Recommended field rate	Tested rate
Neemix (4.5 EC)	Azadirachtin (4.5%)	292.2 mL-1.2 L/ha	1.2 L/ha
M-Pede (SL)	Potassium salts of fatty acids (49%)	1.0-2.0% v/v	2.0% v/v
Entrust (80W)	Spinosad (80%)	104.9-209.8 g/ha	209.8 g/ha
Pyganic (1.4 EC)	Pyrethrins (1.4%)	4.1-8.2 L/ha	8.2 L/ha
Surround (WP)	Kaolin (95%)	28.0-112 kg/ha	14.0 kg/ha
Grandevo[1] (AF)	*Chromobacterium subtsugae* (strain PRAA4-1T)	N/A	5.0% v/v
MBI-205[1] (AF)	Extract of *Eucalyptus* sp.	N/A	5.0% v/v
Venerate[1] (AF)	*Burkholderia* sp.	N/A	5.0% v/v

[1]These materials were experimental biopesticides when this study was conducted. Grandevo and Venerate were named MBI-205 and MBI-206, respectively, when tested in this study.

Lethality Results

- Adults exposed to M-Pede, Entrust, Pyganic, Pyganic + Surround, Grandevo, and Venerate had significantly higher mortality by Day 7 compared with untreated control (water).

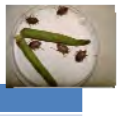


414 *Florida Entomologist* 97(2) June 2014

IMPACT OF ORGANIC INSECTICIDES ON THE SURVIVORSHIP AND MOBILITY OF *HALYOMORPHA HALYS* (STÅL) (HEMIPTERA: PENTATOMIDAE) IN THE LABORATORY

Dong-Hyung Lee[1,*], Brent D. Short[2], Anne L. Nielsen[3] and Tracy C. Leskey[2]
[1]USDA-ARS, Appalachian Fruit Research Station, 2217 Wiltshire Road, Kearneysville, WV 25430-2771
[2]Rutgers University, 121 Northville Rd, Bridgeton, NJ 08302
[*]Corresponding author; E-mail: dl343@cabnr.ack.dk
[3]Current address: Department of Life Sciences, Gachon University Seongnam-si, Gyeonggi-do, Republic of Korea

Bean & filter paper dip bioassays



TRT	Active ingredient	Rate / Acre	Bean Dip			
			Adult (n=20) Average % Mortality at		Nymph (n=20) Average % Mortality at	
			24h	48h	24h	48h
UTC		0	0.0%	1.3%	5.0%	11.1%
Veratran D	Sabadilla Alkaloids (.20%)	240 g	57.5%	57.5%	21.0%	59.0%
Pyganic	**Pyrethrins (5%)**	**17 fl oz**	**82.5%**	**70.0%**	**47.5%**	**30.0%**
Black Hawk	Spinosad (36%)	2.2 g	42.5%	45.0%	17.0%	23.5%
Azera	Azadiractin (1.20%), Pyrethrin (1.40%)	56 fl oz	65.0%	50.0%	22.0%	23.0%
Aza-Direct	Azadiractin (1.20%)	56 fl oz	0.0%	5.0%	10.0%	10.0%
M Pede	Potassium salts of fatty acids (49%)	86 fl oz	5.0%	7.5%	0.0%	0.0%
K Salts + Spinosad		86.32 fl oz	25.0%	22.5%	30.0%	45.0%
Venerate XC	Burkholderia (94.4%)	215.05 fl oz	12.5%	20.0%	0.0%	0.0%

Efficacy of organic insecticides for the control of BMSB in bell peppers, 2014.

Insecticides were applied 19, 25 Aug and 3 and 9 Sept

% fruit with stink bug damage

Treatment	Rate / Acre	29-Aug	17-Sep
UTC	-	10.0	18.8 A
Veratran D (sabadilla)	240 g	7.5	1.3 B
Pyganic (pyrethrins)	17 fl oz	5.0	2.5 B
Blackhawk (spinosad)	2.2 g	6.3	5.0 B
Azera (pyrethrins+ azadirachtins)	56 fl oz	15.0	0.0 B
Aza-direct (azadirachtins)	56 fl oz	13.8	3.8 B
M Pede (K salts of fatty acids)	86 fl oz	15.0	2.5 B
Neudorff 1138 (K salts + spinosad)	86 fl oz	17.5	1.3 B
Venerate (Burkholderia Chromobacteria)	215 fl oz	26.3	3.8 B
P- Value from ANOVA		ns	0.0162

Efficacy of organic insecticides for the control of BMSB in tomatoes, Blacksburg, VA 2014.

Insecticides were applied 19, 25 Aug and 3 and 9 Sept (Kuhar data)

% fruit with stink bug damage

Treatment	Rate / Acre	29-Aug	8-Sep	12-Sep	Cumulative average % damage
UTC	-	31.3	39.0	31.0	33.8
Veratran D (sabadilla)	240 g	30.0	21.0	15.0	22.0
Pyganic (pyrethrins)	17 fl oz	20.0	37.0	20.0	25.7
Blackhawk (spinosad)	2.2 g	42.5	33.0	29.0	34.8
Azera (pyrethrins+ azadirachtins)	56 fl oz	22.5	26.0	15.0	21.2
Aza-direct (azadirachtins)	56 fl oz	23.8	40.0	27.0	30.3
M Pede (K salts of fatty acids)	86 fl oz	23.8	32.0	6.0	20.6
Neudorff 1138 (K salts + spinosad)	86 fl oz	25.0	25.0	27.0	25.7
Venerate (Burkholderia Chromobacteria)	215 fl oz	25.0	21.0	26.0	24.0
P- Value from ANOVA		ns	ns	ns	ns

Insecticide Research on Vegetables (and fruit)

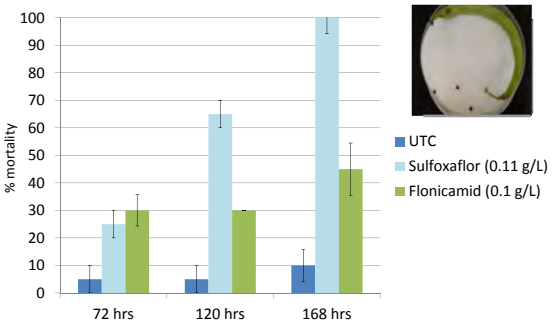
Sulfoxaflor

- New sap-feeding insecticide from Dow Agrosciences (2013)
- Closer 2SC™ for fruit and veggies
  Transform 50WG™ for field crops
- IRAC classification of 4C . A nicotinic acetylcholine receptor agonist that binds at an entirely different site than the neonicotinoids (4A) or nicotine (4B)
- No cross-resistance to neonicotinoids or nicotine
- Demonstrated toxicity against several hemipteran pests such as aphids, leafhoppers, and Lygus bugs

Flonicamid

- Beleaf™ 50SG from FMC
- a pyridinecarboxamide compound
- a novel systemic insecticide with selective activity against hemipteran pests, via inhibition of stylet penetration to plant tissues.
- Inhibits feeding behaviour within 0.5 h of treatment. Mortality from starvation
- antifeeding activity is non recoverable

Bean & filter paper dip bioassays – BMSB 2nd and 3rd instars (Blacksburg, VA)



Sulfoxaflor bean dip bioassays on bugs,

Blacksburg, VA 2013-14

- Sulfoxaflor highly toxic to harlequin bug & kudzu bug at ≥ 218 ppm
- Sulfoxaflor less toxic to BMSB only killing 36-37% of bugs at the highest concentration 436 ppm.

Concentration (ppm)	Harlequin bug		Brown marmorated stink bug		Kudzu bug	
	Nymphs	Adults	Nymphs	Adults	Nymphs	Adults
0	2.5	10.0	3.7	5.0	17.4	0.0
0.001	-	-	-	7.5	-	-
0.01	-	-	-	7.5	-	-
0.1	-	-	-	27.5	-	-
1	10.0	-	4.8	5.0	11.9	-
10	27.5	25.0	15.0	5.0	22.2	7.4
218	75.0	92.5	20.8	7.5	58.5	66.0
436	70.0	97.5	37.0	36.4	58.5	84.1

Field tests bell peppers , Blacksburg, VA

(4 weekly sprays)

Treatment	Rate / acre	% stink bug fruit damage			% control (dmg reduction)	Mean no. green peach aphids / 20 leaves
		8-Aug	19-Aug	30-Aug		
Untr. Control		40.0	15.0	32.5		2.8
Mustang Max	4 fl. oz	7.5	8.8	7.5	72.8	155.0
Brigadier 2SC	8 fl. oz	15.0	7.5	3.8	69.9	0.3
Hero	6.4 fl. oz	17.5	2.5	10.0	65.7	1014.0
Beleaf 50SG	2.8 oz	23.8	7.5	16.3	45.6	1.0
Baythroid XL	2.8 fl. oz	25.0	6.3	10.0	52.8	201.8
Leverage 360	2.8 fl. oz	20.0	8.8	15.0	49.9	0.5

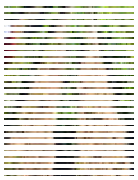
Field tests on bell Peppers , Blacksburg, VA

(4 weekly sprays)

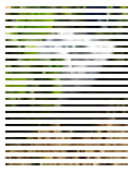
		% stink bug damage to peppers	
Treatment	Rate / acre	12-Aug	4-Sep
Untreated Control		15.0	7.5
Belay 2.13SC + NIS	4 fl. oz + 0.25% v/v	7.5	2.5
Belay 2.13SC + NIS	6 fl. oz + 0.25% v/v	2.5	7.5
Danitol 2.4EC + NIS	21 fl. oz + 0.25% v/v	3.8	6.3
Closer 2SC + NIS	3 fl. oz + 0.25% v/v	2.5	3.8
Closer 2SC + NIS	5 fl. oz + 0.25% v/v	5.0	2.5

BMSB Bioassays on Beans

- Beans were planted 15 June 2014
- Variety 'pinto'
- Normal production followed
- Insecticides were applied 16 July 2014
- Treatments were arranged in a RCBD. 20 feet long X 4 row wide
- After REI:
  - 3 sachets per plot containing 5 BMSB adults/sachet were released
- Data was collected 1, 3 and 7 Days After Treatment (DAT)



Beans at time of application, beginning pot formation, OSU-IAEP (Rondon)



Sachets , OSU-IAEP (Rondon)

Attaching sachets , OSU-IAEP (Rondon)

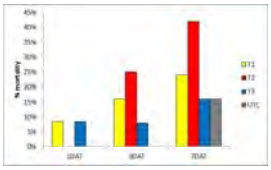
- Residual data
  - Re-release of BMSB were made 2 Weeks After Application (WAP)
  - Percent mortality was taken 1, 2 and 3 Weeks After Release (WAR). Each as independent experiment.
  - Same procedure as described above.

Silvia I. Rondon, OSU

BMSB Bioassays on Beans

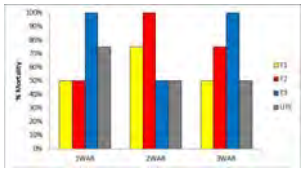
Trt #	Product	a.i.	IRAC group	rate	acres
T1	Beleaf	flonicamid	9C	2.8 oz/a	0.014
T2	Transform	sulfoxaflor	4C	2.3 oz/a	0.014
T3	Asana XL	esfenvalerate	3	9.6 oz/a	0.014
UTC*	Control		-	-	0.014

Efficacy



*DAT Days After Treatment

Residual effect

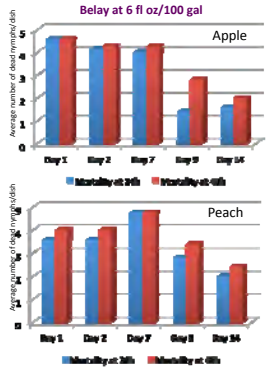


* WAR Week After Release

Silvia I. Rondon, OSU

Determine Efficacy of BMSB Insecticide Residue

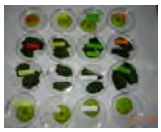
Belay at 6 fl oz/100 gal



BMSB nymphal residual bioassays. (2013 trial)

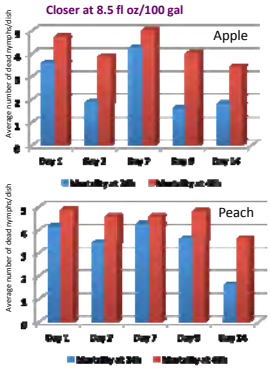
Apple and peach trees were sprayed with backpack sprayer and treated foliage was collected at 1, 2, 7, 9, and 14 day AT. To eliminate the effect of precipitation trees were stored in a greenhouse

Five 2nd instar nymphs were placed per Petri dish and mortality was assessed at 24 and 48 hours after placement on treated foliage.
Seven dishes (35 nymphs) were used per collection.

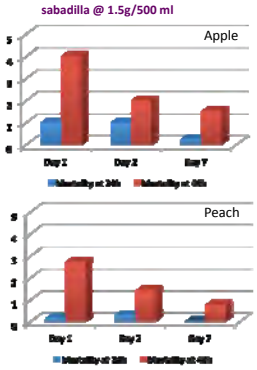


Determine Efficacy of BMSB Insecticide Residue

Closer at 8.5 fl oz/100 gal

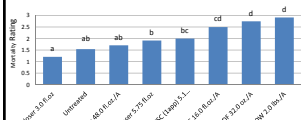


sabadilla @ 1.5g/500 ml

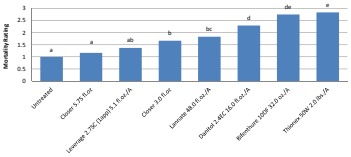


Determine Efficacy of BMSB Insecticide Residue

Nymph BMSB Mortality on Treated Foliage After 7 Days

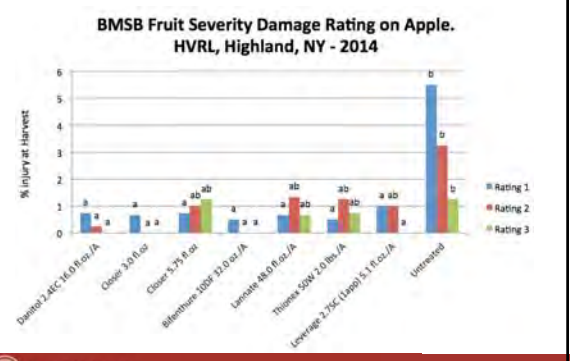


Adult BMSB Mortality on Treated Foliage After 7 Days



Cornell University — Hudson Valley Research Laboratory

Determine Efficacy of BMSB Insecticide Residue



Cornell University — Hudson Valley Research Laboratory

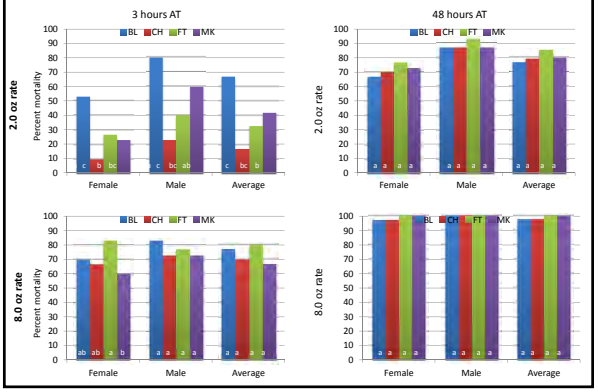
2014 BMSB Insecticide resistance testing: Methods

- Tested individuals — 30 males/females
- Response categories — Alive, dead & moribund
- Observation times — 3, 24 & 48 HAT

Four tested BMSB populations:
CH – commercial orchard; **TF** – commercial orchard;
MK – woods/commercial orchard; **BL** – residential setting

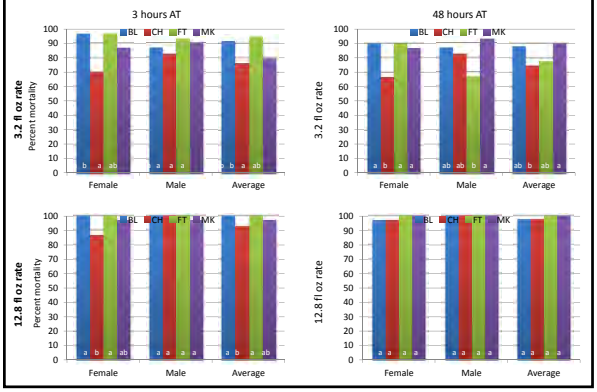
2014 BMSB Insecticide resistance testing: ASSAIL 30 SG

(dead and moribund)



2014 BMSB Insecticide resistance testing: Bifenture EC

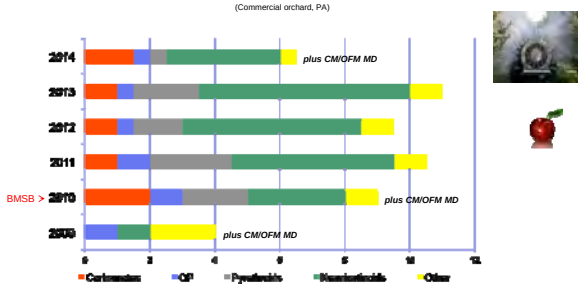
(dead and moribund BMSB adults)



Changes in seasonal insecticide applications - apples

2009-2014 seasons

(Commercial orchard, PA)



Number of insecticide applications per season

Insecticides:
Carbamates (IRAC Group 1A) – methomyl,
Organophosphates (IRAC Group 1B) – phosmet,
Pyrethroids (IRAC Group 3A) – fenpropathrin, lambda cyhalothrin, bifenthrin,
Neonicotinoids (IRAC Group 4A) – acetamiprid, clothianidin, thiamethoxam, dinotefuran, thiacloprid,
Other (IRAC Groups 5, 18, 28) – methoxyfenozide, spinetoram, rynaxypyr.

G. Krawczyk, 2014