

Brown Marmorated Stink Bug IPM Working Group Meeting



**Carroll County Extension Center
700 Agriculture Center
Westminster, MD 21157**

June 12-13, 2012

Submitted by:

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Executive Summary

The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål) continues to spread throughout the United States. BMSB has been detected in 38 states and the District of Columbia with Idaho and Missouri reporting the most recent detections. Large populations are now established in PA, NJ, DE, MD, WV, VA and D.C.; each documented severe losses in crops and serious nuisance problems from BMSB in 2010 and 2011. Established populations also exist in CA, CT, IN, KY, NC, NH, NY, OH, OR, and RI though crop losses have not yet been reported they are considered a nuisance problem only. In addition, BMSB has been detected in AL, AZ, FL, GA, IA, ID, IL, KS, MA, ME, MI, MN, MO, MS, NE, NM, SC, TN, TX, VT, WA, and WI. BMSB has also been repeatedly detected in Hamilton, Ontario, Canada over the past year.

The fifth formal BMSB Working Group meeting was held at the Carroll County Extension Center in Westminster, Maryland on June 12-13, 2012. Research and extension personnel from USDA-ARS, Rutgers University, Penn State University, Cornell University, North Carolina State University, University of Delaware, University of Maryland, Virginia Tech, University of Kentucky, and West Virginia University as well as USDA-APHIS and USDA-AMS, EPA, EPA-IR-4, Northeastern IPM Center, INIFAP Mexico, Ontario Ministry of Agriculture, industry representatives and guest speakers from local pest control companies and Jefferson County Schools, WV attended the meeting. Participants reported on studies of BMSB biology, ecology, behavior, biological control, pheromone trials, voltinism, insecticide evaluations, rearing techniques, new website development (stopbmsb.org) and translations of pertinent Asian literature. Early season field trials with experimental lures across nine states show promising results thus far with early-season attraction documented. Regulatory representatives discussed residue sampling for a Section 18 application for bifenthrin. Consumer issues were discussed following a special session devoted to establishing research and outreach needs for the general public. Eighty-five participants were in attendance and BMSB Working Group membership has almost tripled since the first meeting held in June 2010.

Research Priorities

Rank	Research Priority	Mean Score	# Responders
1	Studies of basic BMSB behavior (host preferences, movement, responses to visual cues)	88	38
2	Biocontrol agents—identification and study of parasitoids, fungal pathogens, and predators (native and foreign)	87	38
3	Development of IPM-friendly management tactics	83	38
4	Identification of true pheromone	82	38
5	Further study of pheromone-based monitoring (e.g. active space, trap design, attractants)	81	38
6	Studies of basic BMSB biology (physiology, generations)	76	38
7	Response of indigenous natural enemies in relation to BMSB densities and their potential for management	74	38
8	Evaluation of parasitoid host specificity	73	38
9	Impact of landscape and habitat on population	72	38
10	Host utilization, preference, and range	71	38
11	Examine overwintering biology (e.g. triggers for seeking and leaving sites; overwintering mortality factors)	70	38
12	Evaluate effects of BMSB management plans on beneficial agents, including pollinators	68	38
13	Evaluate efficacy and host range of candidate classical biological control agents	67	38
13	Standardized sampling methods	67	38
13	Examination of potential for trap-cropping	67	37
13	Identification of potential repellents	67	38
14	Defining damage diagnostics and economics of injury	66	38
14	Determine factors affecting population densities	66	38
14	Investigation of host-plant volatiles as attractants	66	38
15	Crop susceptibility and timing	65	38
16	Assess secondary pest outbreaks related to chemical control of BMSB	58	38
17	Evaluate potential impacts of cultural control measures	57	38

Rank	Research Priority	Mean Score	# Responders
18	Risk analysis of overwintering populations in natural landscapes	55	38
18	Evaluate long term sublethal effects on BMSB (e.g. effects on reproduction)	55	38
19	Mapping and assessment of distribution	54	38
19	Role of the gut symbionts and their potential for management	54	38
20	Evaluate landscape-level/watershed-scale population distribution	52	38
20	Determining monitoring strategies for urban areas	52	38
20	Generate methods and baseline for evaluation of resistance development	52	38
21	For host plant survey, include plant growth, stage and parts	51	38
22	Insecticide toxicity screening/resistance monitoring	49	38
23	Translation and synopsis of research to date from Asia	48	38
23	Genetic studies of BMSB	48	38
24	Standardize methods for insecticide trials and conduct screenings of existing materials	47	38
25	Evaluate impact of orchard groundcover management	44	38
26	Assessment of displacement of native stink bugs	42	38
27	Examination of cross-attraction of BMSB and green stink bugs	39	38
27	Development of toxicants and inhibitors for plant transgenic delivery	39	38
27	Study potential for damage of harvested/value-added crops by contamination with BMSB	39	38
28	Evaluate potential impact of vertebrate predation	38	38
29	Assessment of economic impact in urban environment	37	38

Priority rank is based on scores provided by individual Working Group participants (importance of a particular priority on a scale of 0-100), calculating the mean value for each, and ranking them accordingly.

Extension Priorities

Rank	Extension Priority	Mean Score	# Responders
1	Education programs to growers and the general public	85	35
2	Coordinate efforts of state and regional extension programs	81	35
3	Develop revised and unified management plans	79	35
4	Educating professionals to pest ID and diagnosis of injury	71	35
5	Develop economic injury thresholds	70	35
6	Educational programs relevant to invasive biology using BMSB	65	35
7	Educational programs relevant to development of biological control projects	63	35
8	Develop treatment recommendations and guidelines for urban environments	62	35
9	Evaluation of field application techniques for chemical control	60	35
9	Raise awareness of importance of BMSB as pest – APHIS, local political channels, etc.	60	35
10	Educational programming for structural and landscape industries	59	35
11	Include education programs relevant to classical biological control	59	35
12	Extension outreach and education programming for urban environment/homeowners	58	35
13	Use BMSB as an opportunity to educate children	57	35
13	Initiate public awareness campaigns – posters, public service announcements, educational materials, etc.	57	33
13	Initiate an eXtension community of practice (COP), potentially as a central website for information	57	35
14	Evaluate efficacy of insecticides/killing agents for homeowners	56	35
15	Evaluate materials for home-garden and home-landscape protection	55	35
16	Direct homeowners to local politicians for complaints	45	35
17	Structure extension groups by commodity or region	44	35

Priority rank is based on scores provided by individual Working Group participants (importance of a particular priority on a scale of 0-100), calculating the mean value for each, and ranking them accordingly.

Regulatory Priorities

Rank	Regulatory Priority	Mean Score	# Responders
1	Use of toxins in combination with attractants (regulatory status)	73	36
2	Define the economic and ecological threat	71	36
3	Coordinate interagency and interdisciplinary funding	68	36
4	Expand use of existing registered products	67	36
5	Product testing and labeling of new active ingredients/products	66	36

Priority rank is based on scores provided by individual Working Group participants (importance of a particular priority on a scale of 0-100), calculating the mean value for each, and ranking them accordingly.

Consumer Priorities

Rank	Consumer Priority	Mean Score	# Responders
1	Defining period of movement to homes and triggers for movement	76	35
2	Efficacy and deployment strategies of homeowner traps	73	35
3	Factors associated with selection of overwintering sites	70	35
3	Preventative measures for reducing entry into human-made structures	70	35
4	Efficacy of traps for home garden use	69	35
5	Timing of treatment for homeowners	68	35
6	Forecasting population size	67	35
7	Repellents (push/pull) for homeowners	64	35
8	Important biological control agents around residential areas	63	35
9	Efficacy of treating exterior plants/landscapes	59	35
10	Determining repeated entry and exit by BMSB from overwintering sites	44	35

Priority rank is based on scores provided by individual Working Group participants (importance of a particular priority on a scale of 0-100), calculating the mean value for each, and ranking them accordingly.

Overall Priorities

Rank		Overall Priority	# Votes
1	Research	Studies of basic BMSB behavior (host preferences, movement, responses to visual cues)	21
2	Research	Identification of true pheromone	18
2	Research	Biocontrol agents—identification and study of parasitoids, fungal pathogens, and predators (native and foreign)	18
3	Research	Development of IPM-friendly management tactics	10
4	Research	Studies of basic BMSB biology (physiology, generations)	8
4	Extension	Education programs to growers and the general public	8
5	Research	Further study of pheromone-based monitoring (e.g. active space, trap design, attractants)	7
6	Research	Evaluation of parasitoid host specificity	5
6	Research	Examine overwintering biology (e.g. triggers for seeking and leaving sites; overwintering mortality factors)	5
7	Research	Evaluate effects of BMSB management plans on beneficial agents, including pollinators	4
7	Research	Role of the gut symbionts and their potential for management	4
7	Research	Response of indigenous natural enemies in relation to BMSB densities and their potential for management	4
7	Extension	Coordinate efforts of state and regional extension programs	4
7	Extension	Develop revised and unified management plans	4
7	Regulatory	Product testing and labeling of new active ingredients/products	4

Overall priority rank is based on Working Group participants designating their five top priorities across all categories; those priorities receiving designations by at least 10% of the membership were ranked.

Oral Presentation Summaries

Research and Regulatory Updates

Host plant visual sampling and insecticide efficacy research

Presented by: Thomas Kuhar

**Co-Authors: Katherine Kamminga, Chris Phillips, Anna Wallingford and John Aigner
Virginia Tech**

Department of Entomology

Summary:

- Observations of BMSB in their natural habitat
- Favorite host plants in spring include *Paulownia*, peach, wild mustard, catalpa, wild cherry, mimosa, Ailanthus and mulberry.
- Late June/early July movement into vegetables
- Stink bug species complex – in 2011, 96% adult stink bugs were BMSB in Southwest VA, 22% in Western NC and only 4% in Eastern NC
- In 2012, 80% of stink bug species found in Southwest VA were BMSB
- Insecticide evaluation – permethrin and dinotefuran effective on vegetables
- Alternatives
 - Flonicamid – bug cannot feed
 - Sulfoxaflor - new product (Closer 2SC) or (Transform), effective on nymphs after one week, but minimal efficacy against adults

Artificial diet work & studies to assess role of gut symbionts: results to date

Presented by: Galen Dively

Co-authors: Peter Coffey and Chris Taylor

University of Maryland

Department of Entomology

Summary:

- Colony rearing – used green bean pods and organic bean pods, placed on platforms, put shelled sunflower seeds on top of screen, misted daily
 - Collecting 48 egg masses per day
 - Sending egg masses to other labs to work on cannibalization and to Bayer CropScience for testing BT strains for activity on BMSB
- Sterilization trial – using Clorox to sterilize egg mass
 - Yielded a delay in development and egg laying
 - Saw a delay in adults, more dramatic in 2nd generation
- Development of an artificial diet - deliver toxin through diet – seems promising
 - Replaced potato and tomato powder with soy powder

Is there value in BMSB citizen science data?

Presented by: Peter Jentsch

Co-author: Mike Fargione

Cornell University/Hudson Valley Laboratory

Department of Entomology

Summary:

- Use citizen science to establish “pioneer status” of BMSB in NY
- Allows development of working relationship, establishing outreach and lets people participate
- Communication with media is a resource to help move forward
 - Media generates public interest
 - Web based forms are created, submit specimen, make house calls if necessary
 - 34 counties in NY sent specimens greatest density in southern Hudson Valley
- Not necessarily a solution, but helps give the public the feeling something is being done and that seems to be enough at this point
- Also using host trees as trap crop; maple, ash, *Ailanthus*,
 - Injecting the trees with Acephate
 - Injections occur after bee activity ceases in the trees

StopBMSB.org website preview

Presented by: Elizabeth Myers

NE IPM/Cornell University

Summary:

- Website is an outreach of the BMSB SCRI project
- Audience is growers and advisors
- Going live tentatively in July 2012

Regulatory Updates

Regulatory Updates

Presented by: Clayton Myers

U.S. Environmental Protection Agency

Washington D.C.

Summary:

- Agency reached cumulative finding on pyrethroids which opened up potential new uses
- Seven states have applied for Section 18 for bifenthrin, the same states as for dinotefuran Section 18
- Minor use applications – IR4
- Endosulfan phase out schedule
 - Peaches and nectarines – July 2012
 - Apples - 2015
 - Request for Section 18 possible, but prospects are bleak

- Reauthorization for dinotefuran likely when all paperwork is submitted to agency
- Mark Seetin commented that U.S. Apple lobbied congress on behalf of IR4 in the new Farm Bill

Pesticide data program sampling and testing to support bifenthrin Section 18

Presented by: Chris Pappas

USDA/AMS

Summary:

- Pesticide data program – collects data nationwide, collaborates with EPA
- For bifenthrin, 100 samples each, (apples, peaches) collected at farms and packing houses in MD, WV, VA, NJ, and PA.
- Samples per state will be proportional to production
- When samples are collected, researchers will assign identification numbers to each sample and keep site data confidential.

Consumer Issues

BMSB in the schools

Presented by: Joe Starkey

Jefferson County Schools

Charles Town, WV

Summary:

- Jefferson County Schools had a big problem with BMSB in the schools in 2011
 - Electronic equipment failures caused by infestation of stink bugs in control units. Specifically kitchen equipment, HVAC systems and other electric control boxes have been shorted out and created additional repairs and service calls.
 - HVAC warranty does not allow modifications of any kind so they are limited to what they can do to block intakes and reduce entry
 - The overall appearance of the buildings is greatest concern. Light panels filled with bugs and stained surfaces from their discharge all create an “unclean” and poorly maintained appearance.
 - Portable classrooms seem to be particularly vulnerable. Classrooms completely infested creating a “horror movie” appearance.
 - Had to relocate class until classroom could be cleaned up
 - Students and staff became desensitized and accepted having to cohabitate with them
 - Stadium lighting shorted out causing game to be postponed
 - Increase costs due to additional service calls, manpower and overtime hours
- Information or services:
 - JCS has addressed the stink bug issue by using shopvacs to collect and discard them. Cleaned lights and other areas with hot soapy water. Neither of these offers a solution due to the numbers and persistence of the creatures.

- Need a nontoxic, approved method for in-school control
- 2012 school year did not see the level of infestation as in the previous year

Rentokil North American Pest Control

Presented by: Godfrey Nalyanya

Millersville, MD

Summary:

- Commercial and residential services
- Majority of BMSB issues are residential
 - Treat exterior only, if necessary will do a treatment in the attic
 - Have seen best results when they treat Sept 1-15
- Consumer concerns
 - Do they bite?
 - Will I get sick?
 - Will they damage property, inside and out?
- Addressing consumer issues through education and training by going to ESA meetings and USDA website
 - Emphasize sealing screens, cracks and crevices to help keep them outside
- What they need to help consumer
 - More knowledge on how to treat them
 - Be able to go to one main website or source to find information
 - Forecast of BMSB population density

Commercial and Homemade Trap Comparison

Presented by: John Aigner

Virginia Tech Graduate Student

Summary:

- Experiment driven by his desire to give the consumer a feeling of joy to be able to get rid of the BMSB
- Homemade traps
 - Homemade soda bottle traps, \$7 (created with help from YouTube videos)
 - Lighted water pan trap, \$10
- Commercial traps
 - Rescue light, \$38
 - Strube trap, (light and sticky) \$44
- Results
 - The water pan trap and the Strube Trap were both effective methods
 - The bottle trap and Rescue light trap were ineffective

Patriots Pest Management
Presented by: Joe Lukas
Westminster, MD

Summary:

- Been in the pest management business for over 32 years
- Has tried various power sprays for the exterior of homes
- Has tried dusting the interior attic area
- He feels timing is a key factor in treating for BMSB
- After treatment customers saw some relief and said it made life more livable

Which Ready to Use Product to Use?

Presented by: Michael Raupp
University of Maryland

Summary:

- Evaluate efficacy of “Ready to Use” (RTU) products commonly found in retail outlets
- Stink bugs obtained from field (adults) and colonies (nymphs, eggs)
- Dry residues – bioassay arenas sprayed, allowed to dry 48 hours
- Direct sprays – stink bugs placed in bioassay arenas, sprayed with insecticides
- Carbaryl, permethrin, insecticidal soap, horticultural oil, spinosad, azadirachtin, and acetamiprid were active as direct sprays and dry residues
- Potential recovery of *Halyomorpha halys* following applications of permethrin and acetamiprid deserves further attention
- Before RTU insecticides can be confidently recommended, efficacy of these products as crop protectants should be evaluated in bioassays conducted under greenhouse and field conditions

Facilitated Discussion

Summary:

- Deficiencies and problems for homeowners
 - Timing of treatments
 - Efficacy of treating garden plants/landscapes
 - Triggers for movement to overwintering sites
 - Forecasting
 - Positioning and efficacy of homeowner traps
 - Factors associated with selection of overwintering sites by adults
 - Preventative measures of entrance
 - Repellents (push/pull strategies) for homeowners
 - What are the known predators out there
 - Efficacy of traps for home garden use
- Misconceptions
 - Do they bite?

- Has anyone ever died from or been killed by BMSB?
- Will odor act as bait and attract more next year?
- Will odor produced from smashing attract more?
- What is the health impact, can a large infestation lead to allergic reactions or respiratory issues?
- Are birds a factor in helping control them?
- Do existing traps lead to reduction of damage to backyard gardens?
- Do they come inside to get warm in the winter?
- Opportunities
 - Educate public on invasive species
 - HUD
 - School IPM funding
 - 4H
 - College or University connections to school
 - STEM funding – NSF
 - NIH for allergy research
 - PMO/PCO funds, industry and pest mgt programs
 - Specialty crop grant, State Department of Agriculture
 - Forest Service
 - Park Service
 - EPA
 - Citizens science/private donations

Research/Regulatory Updates

Review of Asian Literature on *Halyomorpha halys*: Process and outcomes

Presented by: Brent Short and Doo-Hyung Lee

Co-author: Shimat Joseph, Chris Bergh, and Tracy Leskey

USDA/ARS Appalachian Fruit Research Station

Summary:

- Began literature review in Asia due to limited U.S. publications
- Wanted to make this literature available to everyone
- Obtained articles from:
 - Ken Funayama and other researchers
 - National Agricultural Library
 - Web-based Databases
 - Google Scholar/Google other countries
 - CNKI Scholar
 - Agricola
 - Scopus
- Challenges:
 - Not knowing what papers exist
 - Missing or incorrect information in some Asian citations

- Older publications
- Origin of publication (internal reports: e.g. government documents)
- Language barrier (no or limited English)
- Funding limitations
- Translation Issues
 - Farm Bill Funding via USDA-APHIS
 - Article Selection Process
 - Translation Service
 - Languages requested
 - Cost per page or per character
 - Turnaround time
 - Original paper may not have standard components American manuscripts follow
 - Lost in translation – spelling, grammar, quality, translated by non-entomologists
- Findings
 - Life history
 - Host Range
 - Phenology/Ecology
 - Sampling/Monitoring
 - Damage/Economic Importance
 - Management

Preliminary results of testing netting in high tunnels and greenhouses to exclude BMSB
Presented by: Stanton Gill
University of Maryland Cooperative Extension

Summary:

- MNLA funded research on herbaceous plants
 - Put plants in greenhouse and put BMSB in there to feed on plants
 - Found that BMSB did not do well in greenhouses
 - Damage was insignificant
- Greenhouse survey done in MD in 2011 and 2012 could not find one greenhouse where BMSB damage was reported. Damage was found around the greenhouses but not inside.

Incorporating female reproductive development into voltinism studies
Presented by: Anne Nielsen
Co-authors: Shelby Fleischer and Mike Saunders
Rutgers University RAREC

Summary:

- Using relative ovarian development to determine phenology/voltinism of adult seasonal population
- Collected adults in Allentown and Biglerville, PA and Kearneysville, WV
- Life stages depend on temperature
- Females are laying up to 2 sets of 28 egg masses within a 24 hour period at temperatures of 27°C and 30°C

- Eggs did not hatch once the temperature reached 35°C
- Voltinism model is going to help determine seasonality
- Separated distinct periods of ovarian development into 5 stages depending on temperature

BMSB Voltinism NY to NC

Presented by: Brent Short

Co-author: Tracy Leskey

USDA/ARS Appalachian Fruit Research Station

Summary:

- Reports have a wide range of data
- U.S. has reported 1-2 generations of BMSB and Asia has reported 1-4 generations
- Using semi-field trials to establish voltinism capacity in NY, NC, PA, and WV

Update on BMSB in Ontario, Canada

Presented by: Hannah Fraser

Ontario Ministry of Agriculture

Summary:

- 2010 media questions started but no evidence of BMSB
- 2011 outreach and monitoring begins in corn and soybean due to mid-Atlantic states crisis
- Goal is early detection since BMSB has not been found in the field they have not initiated any regulatory requirements
 - Scouting, observations and sweep netting at 100 different sites in Ontario – no BMSB were found
 - Set up 45 sites with traps – no BMSB were found
 - City of Hamilton, 2 homeowner finds in September 2011, multiple finds in Nov/Dec and additional finds during the winter
 - Hamilton is an industrial and major transportation area with heavily forested areas
 - Ailanthus, ash and older homes present
 - BMSB coming in through cargo,
 - PVC piping had 100s in a shipment
 - Partnership established with Master Gardeners Education and BMSB working group

Understanding IR-4

Presented by: Edith Lurvey

IR-4 Northeast, Cornell NYSAES

Summary:

- IR-4 supports registration of pest management tools for specialty crops
- Publicly funded program that conducts research and submits petitions to EPA

- Leadership role in global harmonization of registrations
- Partnerships – liaisons for each state
- Bundle requests for chemicals – from chemical companies and state requests to EPA to evaluate for problems
- Food use workshop to prioritize product request
- Your voice is important, contact them, submit Pest Control Requests (PCR)

What we know about the pheromone of the brown marmorated stink bug, *Halyomorpha halys*

Presented by: Ashot Khrimian

**Co-authors: Jeffrey Aldrich, Hsiao-Yung Ho, Aijun Zhang, Tracy Leskey, and Don Weber
USDA/ARS Beltsville, MD**

Summary:

- Provided background on discovery of BMSB pheromone and team inputs
- Fall 2011 discovered highly active #10 and #12 lures
- Bioassay with single stereoisomers will be conducted this season to narrow identification
- Commercial lure is being pursued. Single stereoisomers are expensive but mixtures, such as #10 and #12, are economically feasible

Quarantine screening of exotic parasitoids of BMSB

Presented by: Christine Dieckhoff

**Co-author: Kim Hoelmer
USDA/ARS/BIIRU**

Summary:

- Goal: Evaluate the need for a classical biocontrol project for *Halyomorpha halys*
- Areas covered in Asia were natural forests and parks
 - Pests brought back and placed into quarantine
 - ~4 *Trissolocus* colonies were established in the laboratory
 - Undergoing host specificity screening in DE, MI, FL, MS and OR
 - Each location compiled a list of potential non-target species found in its area
 - Species of interest belong to the families: Pentatomidae, Scutelleridae, Thyreocoridae, Cydnidae, or Acanthosomatidae
 - 19 species in total are considered beneficial

Characterization of overwintering sites of *Halyomorpha halys* in natural landscapes

Presented by: Doo-Hyung Lee

**Co-authors: John Cullum, Sean Wiles, Starker Wright and Tracy Leskey
USDA/ARS Appalachian Fruit Research Station**

Summary:

- No previous information on overwintering sites in the natural landscape when survey was initiated
- Dead trees became a prime target in Nov 2011

- 774 dead trees were checked
 - Found 26 trees with overwintering at a 3% success rate
- 2nd step laid out 47 transects, sampled 529 dead trees
 - Found 14 trees with BMSB overwintering at a 3% success rate
- Targeted sampling based on favorable characteristics of dead trees led to a 33% success rate
- Continue to study whether overwintering in natural landscapes poses a risk to agriculture based on mobility studies and in conjunction with using detector dogs

Early season results from traps baited with experimental pheromone and light-based stimuli

Presented by: Tracy Leskey

USDA/ARS Appalachian Fruit Research Station

Summary:

- Goal is to develop effective monitoring tools
 - Tools that provide accurate measurements of presence, abundance, and seasonal activity of BMSB
 - To enable growers to make informed management decisions
- Key components to trap-based monitoring tools, focused on:
 - Visual Stimuli
 - Olfactory Stimuli
 - Capture Mechanism
 - Deployment Strategy
- Visual Cues
 - Compact fluorescent lights tested as visual stimuli in association with black pyramid traps. Sources included white, black, blue, green, yellow, and red compact fluorescent bulbs and control
 - A total of 21 traps baited with light-based stimuli captured 13,457 adult BMSB in ~6 weeks during late summer
 - Black, blue and white provided greatest level of BMSB captures late in the 2011 season with greatest species specificity in blue traps.
 - Purity trials of #10 indicate that less purified forms are equally active.

Native biological agents of BMSB

Presented by: David Biddinger

Co-authors: Neelendra Joshi and John Tooker

Penn State University

Summary:

- Importance of biological control agents for BMSB being established
- Tachinid parasitism fairly low in 2010 and 2011
- Sand wasps are good predators of BMSB nymphs