BMSB in Ornamental Systems

Ornamentals Commodity Team Participants and Participating Institutions:

University of Maryland – Paula Shrewsbury (coordinator), Pedro Barbosa, Bryon Butler, Stanton Gill, Holly Martinson, Karen Rane, Mike Raupp, Ray St. Leger

University of Delaware – Brian Kunkel

Rutgers University – George Hamilton

USDA ARS Horticultural Crops Research Lab, Corvalis, Oregon – Jana Lee

Oregon State University – Peter Shearer, Nik Wiman

Many graduate students, post docs, technicians, and stakeholders
Ornamental Systems
(woody and herbaceous plants: nurseries, landscapes, greenhouses, high tunnels)

**Objs. 1.2, 1.3:** Damage, Phenology and Impact of BMSB in Ornamental Systems

**Objs. 3.1, 3.2:** Crop Specific IPM Programs in Ornamental Systems
Ornamental Nurseries

Why nurseries?
- Economically important:
  - #2 Ag Sector in MD 2008: ~ $2 billion green industry gross receipts
  - High plant diversity
  - Large blocks of trees

BMSB
- Potentially damaging pest
- Must immigrate, emigrate
- Feed throughout season
- Broad use of ornamentals

Examine abundance, host use and selection, movement patterns, and damage in woody plant nurseries
Woody Ornamentals (MD)

- Abundance over time
- Host utilization
- Damage by BMSB
- Plant phenology
BMSB Egg Abundance Over Time

• Sampled three nurseries at regular intervals from late May through September 2012 and 2013
• Visual searches of foliage on *Acer*, *Prunus*, and *Ulmus*
Total Number of BMSB Eggs

Suggests 2 generations / year in MD

BMSB active stages:
- Immigration began 3rd week of May
- Heavy infestations by 1st week of July
- Emigration began mid-August with few BMSB by late Sept.

Number of Eggs

Sampling Period

A. Jones et al., UMD
Host Utilization - Study Site

Raemelton Farm
Western MD
Wholesale Commercial Nursery
~300 Acres
BMSB pressure ~4 years
Host Utilization - Survey Methods

2011-2013
1 min visual counts:
Leaves ▪ Fruit ▪ Bark

BMSB stages:
Egg Masses
Nymphs
Adults

2\textsuperscript{nd} nursery data to be analyzed

E. Bergmann et al., UMD
Host Utilization - Scope of Survey

- 258 cultivars
- 4,247 individual plants
- 35,767 tree visits
- 24,440 stink bugs and egg masses

2011-2013
Total cultivars sampled: 258
Total used by any stage: 202
Cultivars used by Eggs: 86 (34%)
Cultivars used by Nymphs: 167 (64%)
Cultivars used by Adults: 192 (74%)
Cultivars not used: 56

Patterns of Host Use

78% of cultivars used

E. Bergmann et al., UMD
BMSB distribution within woody plants

2011 & 2012
Part: P < 0.02

Martinson, Raupp, Shrewsbury (in press)
*Annals of the Entomological Society*
Late Nymphs + Adults

2011

2012

Part: P < 0.04
Time: P < 0.0001
Part: Time: P < 0.01
BMSB feeding damage to woody trees

Possible damage
- Direct feeding
- Indirect as disease vector
### Monitoring in Oregon Nurseries

<table>
<thead>
<tr>
<th>Year</th>
<th>Sites</th>
<th>Plants</th>
<th>BMSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>14 sites in Canby and Dayton</td>
<td>Cherry, Crabapple, Elm, Euonymus, Hawthorne, Mixed hedge, Pear, Plum (unsprayed), Poplar, Syringa</td>
<td>Sep 8 (beat), Oct 7 (trap) in plum</td>
</tr>
<tr>
<td>2012</td>
<td>16 sites spread over 100 miles</td>
<td>Apple, Cherry, Conifer, Cornus, Crabapple, Euonymus, Hawthorne, Laurel, Mixed hedge, Oak, Plum (unsprayed), Rose</td>
<td>😞 Despite high efforts</td>
</tr>
<tr>
<td>2013</td>
<td>3 sites in Canby, Dayton, Portland</td>
<td>Mixed hedge near abandoned orchard, Plum (unsprayed), Retail mix</td>
<td>Aug 14 – Oct 23 (trap)</td>
</tr>
</tbody>
</table>

- Each site has a Pyramid trap or Rescue trap, and Beat 100 plants
- Densities low
- In 2014:
  - Minimal trapping with main stakeholder nurseries, this is not providing much information
  - Trap & beat in abandoned holly orchard

J. Lee, USDA ARS, N. Wiman, P. Shearer, Oregon State Univ.
BMSB Nursery Survey (NJ)

Methods

• Nursery block with diversity of tree species (8+)
• Sampled weekly
  – Beat sampling (5/tree)
• Multiple trees per species sampled
  – Mean # nymphs and adults / tree

American ash
Green ash
Horse chestnut
Popular
Redbud
Sugar maple
Sweet gum
Weeping Cherry

Photo by Steve Black
Photo by Ruppert Nurseries

G. Hamilton, Rutgers, NJ
BMSB Nursery Survey (NJ)

Results

• 2012
  – Abundance varied by tree species and time
  – Low densities (range 0 – 2 / tree)

• 2013
  – Abundance was very low, mostly “0”s
BMSB Activity on Herbaceous Plants and Cut Flowers (MD, DE)

- To establish if BMSB feeds on herbaceous perennials

- To establish if BMSB feeds on specialty cut flowers

- If they feed, determine if there is detectable damage to the plants from feeding or any disease transmission to the plants

S. Gill, K. Rane, UMD; B. Kunkel, UDel, 2013
Herbaceous Perennial and Cut Flower Nurseries monitored in 2013

- Grasshopper Nursery, Knoxville, MD (Washington County)
- Glade Nursery, Walkersville, MD (Washington County)
- North Creek Nursery, PA
- Holly Hill Nursery, Earlsville, MD
- Marshall River Bank Nursery, Salisbury, MD
- Farmhouse Flowers and Plants, MD

- Weekly or bi-weekly visual timed sampling
Trap baited with #10 USDA pheromone and standard pheromone and kill strip Vapona strip placed at each nursery and cut flower operation that was monitored to verify BMSB pressure was present.
Herbaceous Perennial Operations monitored in 2013

- Grasshopper Nursery, Knoxville, MD (Washington County)
- Glade Nursery, Walkersville, MD (Washington County)
- North Creek Nursery, PA
- Holly Hill Nursery, Earlsville, MD
- Marshall River Bank Nursery, Salisbury, MD
- Farmhouse Flowers and Plants, MD
Cut flower - Amaranth:
Before bloom no BMSB
When in flower and seed production = high BMSB

Note damage to foliage form amaranth leaf beetle
Cut flower – Sunflower: Stink bugs like to feed on unopened sunflower buds

Feeding on leaves and stems but no damaged detected
Cut flower - Zinnias:
Adults feed on flower parts, stems and leaves; and unopened flower buds
Some egg laying on foliage
August 3 – 14, 2013 BMSB were all over gladiolus leaves, stems and unopened flower buds

Cut flowers - Gladiolus
• Injury detected on leaves and flower buds; flowers opened normal
• Negative for any disease transmission
BMSBs preferred to feed on flowers, buds, or just under a bud (on the swollen peduncle/receptacle of a flower) and newly forming seeds or seedpods when existing on plants. No feeding damage was found on any perennial. The following perennial plant species/cultivars were documented with active BMSB feeding:

- **Feeding on foliage** (7 different plants, total of 31 BMSBs)
  - Lychnis 'Maltese Cross'
  - Caryopteris 'Dark Knight' (Blue mist shrub)
  - *Polemonium viscosum* 'Blue whirl' (Jacob's-Ladder)
  - Veronica 'Sunny Border Blue'
  - *Althea lasiocarpus* (= *Hibiscus moscheutos* subsp. *lasiocarpos*, Hairy rose mallow)
  - Monarda 'Marshall's Delight' (Bee balm)
  - Phlox 'Franz Schubert'
Conclusion: Perennials

- BMSBs were active at Grasshopper Perennial Nursery but did not cause aesthetic nor economic damage to perennials
- The top 2 preferred perennial species that were both fed upon and visited by BMSB were *Althea lasiocarpus* and *Caryopteris* ‘Dark Knight’, followed by *Veronica* ‘Sunny Border Blue’, Hollyhock ‘Halo Blossom’, and Baptista
- A total of 29 different perennial plant species attracted BMSBs
- No sign of disease / pathogens
Future Directions

Sampling:
Spatial Replication (2nd Nursery)
Monitoring – associate Degree Days with development, activity

Damage:
Bark feeding by BMSB (pathogens, stress, growth)

Phenology and Movement:
Does BMSB track resources through time and space

Host origin effects:
Are plants you “don’t know” at greater risk than plants you “know”

Designing sustainable landscapes:
Avoid plants used for oviposition and feeding
Progress Toward IPM Programs in Ornamental Systems
Research Based Information
Sustaining IPM Programs

• BMSB biology / phenology
  – Associate significant life cycle activities (eggs, nymphs, etc.) with degree days
  – 2 generations/yr; active May – Sept.

• BMSB patterns in ornamental host use
  – Host utilization patterns on woody ornamental, herbaceous perennial, cut flower hosts (identify key plants)
  – Appear to track resources (ex. fruit, seed)

• Spatial dynamics and movement
  – Immigration / emigration; edge effects; patch dynamics
  – Landscape plants / overwintering populations in structures

• Chemical efficacy
  – No consistent significant damage to date

• Biological control
  – Native egg parasitoids / predators are suppressing BMSB (~58% egg mortality)
  – Plant species, hosts that favor native natural enemies
Designing BMSB-free Landscapes

• Avoid use of highly utilized plants
  – Angiosperms used more than gymnosperms (evergreens)
  – Preliminary data suggest BMSB use hosts they don’t know (U.S. natives, non-Asian) more so than hosts they know (Asian)
  – Preliminary data suggest BMSB use plants with fruit and seeds

• Incorporate use of less utilized plants

• Incorporate plants that favor native natural enemies
Woody Plant Utilization by BMSB (nymphs and adults)

Cultivars most used (top 15)

- *Sophora japonica* 'Millstone'
- *Syringa pekinensis* 'Morton'
- *Syringa pekinensis* 'Zhang Zhiming'
- *Evodia daniellii*
- *Acer x freemanii* 'Jeffersred'
- *Gleditsia triacanthos* 'Shademaster'
- *Cercis canadensis* 'Alba'
- *Acer pensylvanicum*
- *Malus* 'Mary Potter'
- *Acer rubrum* 'October Glory'
- *Cornus florida* x *kousa* 'Celestial'
- *Hibiscus syriacus* 'Satin Blue'
- *Carya illinoinensis* 'Choctaw'
- *Ulmus americana* 'Valley Forge'
- *Acer rubrum* 'Brandywine'

3 years of data

E. Bergmann et al. in prep, UMD
Woody Plant Utilization by BMSB (nymphs and adults)

Genus species not used (56 cultivars)

- Abies nordmanniana
- Acer davidii
- Acer palmatum
- Aesculus spp.
- Cedrus atlantic
- Cedrus deodara
- Cercidiphyllum japonicum
- Chamaecyparis obtusa
- Cladrastis kentukea
- Cornus kousa
- Cryptomeria japonica
- Ginkgo biloba
- Hamamelis x intermedia
- Juniperus chinensis
- Nyssa sylvatica
- Physocarpus opulifolius
- Picea breweriana
- Picea koraiensis
- Picea meyeri
- Picea omorika
- Picea pungens
- Pinus cembra
- Pinus densiflora
- Pinus koraiensis
- Pinus nigra
- Pinus parviflora
- Pinus strobus
- Pinus thunbergii
- Prunus mume
- Prunus serrulata
- Quercus robur
- Sequoiadendron giganteum
- Taxus x media
- Thuja plicata
- Tsuga canadensis

3 years of data

E. Bergmann et al. in prep, UMD
Designing BMSB-free Landscapes

- Reduce BMSB abundance in landscapes that surround homes, structures, etc.
- Should reduce abundance of BMSB entering structures to overwinter
Questions?
Pitfalls, Future Plans, Expected Outcomes

Pitfalls

• Low densities of BMSB in autumn in 2011 and early season of 2012, and on herbaceous plants in general, may reduce sensitivity in resolving seasonal patterns in BMSB phenology and injury to plants

• Difficult to separate direct BMSB damage from other causes

• Difficult to document indirect damage to ornamentals (ex. vector, secondary pathogens)

• Standardizing sampling methods across structurally diverse plants / crops

Future plans

• Complete second year of nursery surveys of BMSB phenology; integrate Degree Day information, plant phenology data

• Implement manipulated studies to:
  – determine relationship between BMSB and damage to woody and herbaceous plants
  – elucidate effects of bark feeding on tree health and susceptibility to secondary pathogens

Expected outcomes

• Elucidate timing of initial immigration and oviposition, and predict seasonal changes in populations in nurseries

• Help stakeholders to:
  – Refine IPM programs (monitoring and management of BMSB)