Stink Bugs in Field and Vegetable Crops
Ongoing Research and Extension Activities

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What IS that Smell??!!

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Stink Bugs in Field and Vegetable Crops

- Cool-season vegetable crops
  - Bagrada bug
- Rice
  - Redshouldered stink bug
  - Brown marmorated stink bug (BMSB)
- Cotton
  - Brown stink bug
- Other
Stink Bugs in Field and Vegetable Crops

**Invasive Species**
- 6 new species establish in CA annually
- Cost of $3 billion annually
- With insects very difficult to predict which species will appear and which will establish
- BMSB – predicted
- Bagrada bug – not really

**Native Species**
- Changing conditions
Stink Bugs

**Why so many problems?**

- most are difficult to kill with insecticides
- using more selective products
- not exposed to insecticides due to habits
- most have wide host range
- more riparian habitats, weedy areas which favor stink bugs
- they move indoors for winter in a diapause state
- crawl into tight spaces – perfect for “hitchhiking”
- global travel
Some are beneficial acting as predators

Plant feeding stink bugs are seed feeders
Also commonly feed on seedlings
Stink Bugs

• are commonly eaten in Laos
• regarded as delicious due to their extremely strong odor
• sometimes pounded together with spices and a seasoning to prepare cheo - a paste mixed with chilies and herbs.
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• Rice

• reports from one rice production area in Sacramento Valley of some pecky rice
  • low level but consistently seen
  • we searched for insect-related cause
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- Rice
  - reports from one rice production area in Sacramento Valley of some pecky rice
    - found few Redshouldered stink bug
    - one report from Mississippi of this species feeding on rice
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Redshouldered stink bugs
- pest of tomatoes and other crops
- prefers grasses
- Biology changing?
  - initially was told we could not find them in early Aug. because the second generation was finished
- commonly found them
- studied in rice 2013-14
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2 stink bugs
Stink Bugs in Field and Vegetable Crops

Ongoing Research and Extension Activities

redshouldered stink bug panicle study

Grain Yield from 15 Panicles

- Red Shouldered milk stage
- Empty cage milk stage
- Red Shouldered late timing
- Empty cage late timing

Raw Yield (g)

0 10 20 30 40 50 60 70

Percentage of Pecky Rice

- Red Shouldered milk stage
- Empty cage milk stage
- Red Shouldered late timing
- Empty cage late timing

Percent Pecky Rice

0 1 2 3 4 5 6
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redshouldered stink bug study

• Surveyed 40 rice fields in Sacramento Valley rice for stink bugs
• Fields with higher stink bug numbers
  • weedy fields (grassy weeds)
  • fields near riparian habitat
  • fields in areas with more crop diversity (row crops)
• nightshade and wild tomatillos
• Johnson grass and sprangletop

<table>
<thead>
<tr>
<th>County</th>
<th>Fields</th>
<th>Positive</th>
</tr>
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<tbody>
<tr>
<td>Butte</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Colusa</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Glenn</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Sutter</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Yolo</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Yuba</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>
Stink Bugs in Field and Vegetable Crops

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  - Bagrada bug
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- Cotton
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- Other
Cotton Susceptibility to Stink Bugs
Reproductive Structures

Bolls susceptible to stink bug damage for about 25 days past anthesis. Prefer medium sized bolls, small bolls abscise, larger bolls remain on the plant.

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Stink Bugs in Field and Vegetable Crops

Ongoing Research and Extension Activities

• Bagrada Bug
  • *Bagrada hilaris*
  • first found in June 2008 in Los Angeles Co.
  • establishment of Bagrada bug in California is a new USA and Western Hemisphere record
  • quickly spread across southern California and southern Arizona
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Ongoing Research and Extension Activities

• Bagrada Bug

images: infonet-biovision.org
Stink Bugs in Field and Vegetable Crops

Ongoing Research and Extension Activities

- Bagrada Bug
  - native to East and Southern Africa, Egypt, Zaire and Senegal
  - also found in southern Asia (India) and southern Europe (Malta and Italy)
  - sub-tropical insect
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Ongoing Research and Extension Activities

• Bagrada Bug
  • causing severe crop, nursery, and landscape losses
  • in agriculture, Bagrada bug is a pest of cole crops and other mustard family plants
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Ongoing Research and Extension Activities

- Bagrada Bug Hosts
  - is a serious pest of cole crops (cabbage, cauliflower, broccoli, kale, turnip and mustard greens) and cruciferous crops such as radish and arugala
    - one adult can kill a seedling in few days
  - in nurseries - mustard family plants such as alyssum, stock, candytuft, rockcress and wallflower
  - infests weeds such as lambsquarters, purple nutsedge, Euphorbia spp, perennial sowthistle and field bindweed
Stink Bugs in Field and Vegetable Crops

Ongoing Research and Extension Activities

• Bagrada Bug Hosts
  • has also been recorded attacking papaya, potato, maize, sorghum, cotton, corn, and some legumes
  • Bagrada bug may aggregate on many types of plants at times when populations are high and food is scarce -- strawberries
  • southern CA and AZ – cole crops grown in fall to spring
  • where Bagrada bugs are in the summer is not clear
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Ongoing Research and Extension Activities

• Bagrada Bug
  • a warm season pest which thrives in the heat
  • optimum average temperatures for Bagrada bug growth range from 86 to 95 °F
  • excellent research has been conducted in desert vegetable system
  • hopeful it would not move up coast
  • but .....
Stink Bugs in Field and Vegetable Crops
Ongoing Research and Extension Activities

• Bagrada Bug
## Stink Bugs in Field and Vegetable Crops

### Ongoing Research and Extension Activities

**Objective 1.) Bagrada bug biology in Salinas Valley.**
- Investigate the host use pattern of Bagrada bug in the Salinas Valley
- Investigate the number of generations per year of Bagrada bug in Salinas Valley

**Objective 2.) Infestation & damage severity of Bagrada bug to broccoli and cauliflower in Salinas Valley.**
- Identify windows of vulnerability of broccoli and cauliflower to injury by Bagrada bug throughout the growing period
- Identify yield impacts to broccoli and cauliflower by Bagrada bug

**Objective 3.) Design management plans for Bagrada bug on broccoli and cauliflower in the Salinas Valley.**
- Relay cropping to reduce the damage from Bagrada bug
- Conventional insecticides for Bagrada bug management
- Biological insecticides for Bagrada bug management

**Objective 4.) Extend results.**

- **Bagrada Bug**
- Specialty Crop Grant program
- L. Godfrey, S. Joseph, R. Smith, S. Dara
- started late 2014
Soilless assay: Trial 1, after 7-d

- Injured leaves per ger. Seed
- Feeding punctures per ger. Seed
- Seeds germinated

[Graph showing data for various plants]
### Overall Bagrada bug preference to germinating seeds

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<thead>
<tr>
<th></th>
<th>Preferred</th>
<th>Not preferred</th>
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<tbody>
<tr>
<td>Broccoli</td>
<td>xxx</td>
<td></td>
</tr>
<tr>
<td>Cauliflower</td>
<td>xxxxxx</td>
<td></td>
</tr>
<tr>
<td>Turnip</td>
<td>xxxxxx</td>
<td></td>
</tr>
<tr>
<td>Mizuna</td>
<td>xx</td>
<td></td>
</tr>
<tr>
<td>Bok Choy</td>
<td>xxx</td>
<td></td>
</tr>
<tr>
<td>Arugula</td>
<td>xxxxxx</td>
<td></td>
</tr>
<tr>
<td>Kale</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Lettuce</td>
<td>xxxxxx</td>
<td></td>
</tr>
<tr>
<td>Sweet Alyssum</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>
## Trial 2: Spray trial

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Application timing</th>
<th>No. of applications</th>
<th>Rate per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belay</td>
<td>At plant</td>
<td>1</td>
<td>12 fl oz</td>
</tr>
<tr>
<td>Venom</td>
<td>At plant</td>
<td>1</td>
<td>6 oz</td>
</tr>
<tr>
<td>Admire pro</td>
<td>At plant</td>
<td>1</td>
<td>10.5 fl oz</td>
</tr>
<tr>
<td>Platinum</td>
<td>At plant</td>
<td>1</td>
<td>3.67 oz</td>
</tr>
<tr>
<td>Venom</td>
<td>Plt emer</td>
<td>2</td>
<td>4 oz</td>
</tr>
<tr>
<td>Beleaf</td>
<td>Plt emer</td>
<td>2</td>
<td>2.85 oz</td>
</tr>
<tr>
<td>IKI-3106</td>
<td>Plt emer</td>
<td>2</td>
<td>22 fl oz</td>
</tr>
<tr>
<td>Warrior</td>
<td>Plt emer</td>
<td>2</td>
<td>1.92 fl oz</td>
</tr>
<tr>
<td>EndigoZC</td>
<td>Plt emer</td>
<td>2</td>
<td>4.5 fl oz</td>
</tr>
<tr>
<td>EndigoZCX</td>
<td>Plt emer</td>
<td>2</td>
<td>4.5 fl oz</td>
</tr>
<tr>
<td>UTC</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2 WAP: On cotyledon leaves

Mean number of feeding sites per plot

- Belay_P
- Venom_P
- Admire Pro_P
- Platinum_P
- Venom
- Beleaf
- IKI-3106
- Warrior
- EndigoZC
- EndigoZCX
- UTC

Legend:
- a-c
- b-d
- cd
- d
- cd
- b-d
- a-c
- ab
- a
Summary

• Venom (Dinotefuran) is fast acting on bagrada bug
• At plant banded application is effective but delayed efficacy
• Admire Pro and Platinum showed the most delayed efficacy
• In general, pyrethroids and neonicotinoids have a better efficacy on bagrada bug
Stink Bugs in Field and Vegetable Crops

Ongoing Research and Extension Activities

- Bagrada Bug Management
- Cultural control
  - remove weedy mustards
  - trap crops/relay cropping??
- Biological control
  - being researched
- Mechanical
  - Bug-vacs
  - screening for greenhouses
Stink Bugs in Field and Vegetable Crops

Ongoing Research and Extension Activities

• Bagrada Bug Management

• Insecticides
  • somewhat easier to kill with insecticides than other stink bugs
  • Pyrethroids
  • Organophosphates and carbamates
  • Neonicotinoids – foliar and seed treatments

• re-invasion common and quick

• some evidence bugs drop off leaves to avoid insecticides

• organic control – very limited
Stink Bugs in Field and Vegetable Crops

Ongoing Research and Extension Activities

• Bagrada Bug Management
• drop to soil if disturbed
• will be become active until 75-80 °F
• infestations are very localized
Stink Bugs in Field and Vegetable Crops

Ongoing Research and Extension Activities

• Brown marmorated stink bug (BMSB)
• had to do work in Contained Research Facility
• colony of BMSB in quarantine
Brown Marmorated Stink Bug

[Map showing the spread of BMSB in the United States, with states color-coded to indicate the severity of infestation.]
Brown Marmorated Stink Bug

- fall BMSB adults aggregate in large numbers on the sides of buildings or on trees
- move to protected places and overwinter as adults in a state of facultative diapause (resting stage)
- adults become active in the spring; and after feeding for about 2 weeks, they mate
- females begin to lay eggs in clusters of 20 to 28 with a range of 212 to 486 per lifetime
- mid-Atlantic states, there are one or two generations per year
- number in California is unknown
Brown Marmorated Stink Bug

**Damage**

- feed on over 100 host plants, including tree fruit, vegetables, shade trees, and leguminous crops.
- in the mid-Atlantic, the crops most affected are apple, pear, peach, nectarine, lima bean, snap pea, pepper, sweet corn, tomato, field corn, and soybean.
- other identified crop hosts include raspberry, blueberry, cotton, grape, hazelnut, pecan, cucumber, and pole and bush bean.
- mid-Atlantic states in 2010 - a major outbreak that resulted in damages to fruit, vegetable, field and ornamental crops that exceeded $100 million
Kudzu Bug

- not a stink bug but a close relative – a Plataeidae
- called a bean plataspied
- pest of soybeans in the SE U.S.
- aggregate on houses in the spring and fall
Kudzu Bug

DISTRIBUTION MAP

kudzu bug (Megacopta cribraria) January 1, 2009 - December 31, 2014

Legend
- Green: 2009
- Dark Green: 2010
- Yellow: 2011
- Orange: 2012
- Blue: 2013
- Red: 2014
Stink Bugs

**Why so many?**

- most are difficult to kill with insecticides
- using more selective products
- not exposed to insecticides
- most wide host range
- more riparian habitats, weedy areas
- move indoors for winter
- crawl into tight spaces – perfect for “hitchhiking”
- global travel