Evaluation of Insect Repellents and Barriers as Methods to Control Cucumber Mosaic Virus of Bell Peppers

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UC Cooperative Extension-Kern
Cucumber Mosaic Virus

- CMV has been afflicting peppers in Kern County for 5 years.
- Appears most heavily in the southern end of the county near Mettler.
- Some years worst than others.
- The earlier it appears in the season, the more damage occurs.
- Is aphid transmitted.
Control of CMV

• Essentially none-remove weeds around field and reflective mulches

• Plants are treated with imidacloprid as seedlings in greenhouses.

• Imidacloprid treatments continue through season.

• Organic fields treated with biologicals.
  - Lady bug release
  - Lacewing, etc
Control of CMV

- Even with insecticide treatments, aphids will probe and transmit the virus before it is killed.

- Must prevent aphids from landing on plants.
2008 Trial

1. Control
2. Citronella Oil
3. Citronella/Clove/Geranium
4. Clove/Rosemary
5. Garlic Oil
6. Garlic/Citronella
7. Floating Row Cover
8. Silver Reflective Mulch
2009 & 2010 Trial

1. Control
2. Black
3. Silver reflective
4. Silver
5. White
6. Green
7. Red
8. Surround Canopy
9. Surround Soil
Surround on Soil Surface
Surround on Canopy
Total Fresh Weight

- Control
- Black
- Silver reflective
- Silver
- White
- Green
- Red
- Surround Canopy
- Surround Soil

2010
2010

Total Dry Weight

1. Control
2. Black
3. Silver reflective
4. Silver
5. White
6. Green
7. Red
8. Surround Canopy
9. Surround Soil

grams

Series3

123456789
Yellow Sticky Cards – placed above canopy
Weekly aphid and thrips counts
Aphid Trap Counts

Number of Aphids

2010

Aphid Trap Counts

[Graph showing aphid trap counts from 3/29/2010 to 5/31/2010, with different colors representing different treatments:
1. Control
2. Black
3. Silver reflective
4. Silver
5. White
6. Green
7. Red
8. Surround Canopy
9. Surround Soil]
Total Aphids for Season

- **1. Control**
- **2. Black**
- **3. Silver reflective**
- **4. Silver**
- **5. White**
- **6. Green**
- **7. Red**
- **8. Surround Canopy**
- **9. Surround Soil**

Number of Aphids:
- **Control** (a)
- **Black**, **Silver reflective**, **Silver** (bcd)
- **White** (bc)
- **Green**, **Red**, **Surround Canopy**, **Surround Soil** (cd)

2010
Weekly Aphid Counts 2009

Number Aphids per Trap

Control  Floating cover  Reflective mulch  Green mulch  Red Mulch  Black Mulch  Silver Mulch  Surround/Ground  Surround/Canopy  White Mulch
Weekly Aphid Count

2008 Aphid Counts

1. Control
2. Citronella
3. Citronella/Clove Oil/Geranium
4. Clove oil/Rosemary oil
5. Garlic oil
6. Garlic oil/Citronella oil
7. Floating Row Cover
8. Reflective Mulch
The figure shows the total number of thrips for the season categorized by different treatments:

- **Control**
- **Black**
- **Silver reflective**
- **Silver**
- **White**
- **Green**
- **Red**
- **Surround Canopy**
- **Surround Soil**

The treatments are ordered from lowest to highest total thrips counts as follows:

1. **Control**
2. **Black**
3. **Silver reflective**
4. **Silver**
5. **White**
6. **Green**
7. **Red**
8. **Surround Canopy**
9. **Surround Soil**

The tallest bar represents the highest total thrips count, while the shortest bar represents the lowest. Letters above the bars indicate statistical significance groups, with different letters indicating different groups.
Weekly Thrip Counts 2009

Number Thrips per Trap

Control
Floating Cover
Reflective Mulch
Green Mulch
Red Mulch
Black Mulch
Silver Mulch
Surround/Ground
Surround/Canopy
White Mulch

Data points for weekly thrip counts from April 21 to May 25, 2009, for various treatments including Control, Floating Cover, Reflective Mulch, Green Mulch, Red Mulch, Black Mulch, Silver Mulch, Surround/Ground, Surround/Canopy, and White Mulch.
### 2010 Harvest Data

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Market</th>
<th>Process</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control</td>
<td>6.7 abc</td>
<td>3.4</td>
<td>10.1</td>
</tr>
<tr>
<td>2. Black</td>
<td>7.4 ab</td>
<td>3.4</td>
<td>10.7</td>
</tr>
<tr>
<td>3. Silver Reflective</td>
<td>5.5 c</td>
<td>3.5</td>
<td>9.0</td>
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<td>4. Silver</td>
<td>8.4 a</td>
<td>3.6</td>
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<td>5. White</td>
<td>6.5 bc</td>
<td>3.2</td>
<td>9.7</td>
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<tr>
<td>6. Green</td>
<td>7.5 ab</td>
<td>2.9</td>
<td>10.4</td>
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<tr>
<td>7. Red</td>
<td>7.3 ab</td>
<td>3.8</td>
<td>11.1</td>
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<td>8. Surround Canopy</td>
<td>5.6 c</td>
<td>3.6</td>
<td>9.2</td>
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<td>9. Surround Soil</td>
<td>6.9 abc</td>
<td>3.4</td>
<td>10.3</td>
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</tbody>
</table>

P= 0.0425, %CV= 17.31, LSDp=0.05
Harvested Weights of 12 plants

- 1. Control
- 2. Black reflective
- 3. Silver reflective
- 4. Silver
- 5. White
- 6. Green
- 7. Red
- 8. Surround Canopy
- 9. Surround Soil

Kg

Processing
Marketable
## 2009 Harvest Weights (lbs)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>BB’s Marketable Wt</th>
<th>Cull Wt</th>
<th>Total Marketable Wt</th>
<th>Total Processing Wt</th>
<th>Total Wt</th>
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</thead>
<tbody>
<tr>
<td>1. Control</td>
<td>1.14</td>
<td>0.12</td>
<td>16.61 BC</td>
<td>5.53 BC</td>
<td>22.14 BC</td>
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<tr>
<td>2. Row Cover</td>
<td>1.16</td>
<td>0.00</td>
<td>4.91 D</td>
<td>2.66 C</td>
<td>7.58 D</td>
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<tr>
<td>3. Silver Reflective Mulch 1.11</td>
<td>0.00</td>
<td>16.49 BC</td>
<td>4.56 C</td>
<td>21.04 C</td>
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<tr>
<td>4. Green Mulch</td>
<td>0.76</td>
<td>0.41</td>
<td>18.26 ABC</td>
<td>9.63 AB</td>
<td>27.89 A</td>
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<tr>
<td>5. Red Mulch</td>
<td>0.69</td>
<td>0.76</td>
<td>22.68 A</td>
<td>6.49 ABC</td>
<td>29.16 A</td>
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<tr>
<td>6. Black Mulch</td>
<td>1.15</td>
<td>0.59</td>
<td>20.33 AB</td>
<td>5.09 BC</td>
<td>25.11 ABC</td>
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<td>7. Silver Mulch</td>
<td>0.64</td>
<td>0.10</td>
<td>18.60 ABC</td>
<td>5.51 BC</td>
<td>24.11 ABC</td>
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<tr>
<td>8. Surround Mulch</td>
<td>0.55</td>
<td>0.33</td>
<td>15.20 BC</td>
<td>10.81 A</td>
<td>26.66 AB</td>
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<td>9. Surround Whitewash</td>
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<td>0.26</td>
<td>17.80 ABC</td>
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<td>10. White Mulch</td>
<td>0.95</td>
<td>0.26</td>
<td>14.73 C</td>
<td>7.08 ABC</td>
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**P=0.05**

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<th></th>
<th>0.5772</th>
<th>0.2142</th>
<th>0.0001</th>
<th>0.0454</th>
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<tbody>
<tr>
<td><strong>% CV</strong></td>
<td>56.11</td>
<td>146.59</td>
<td>21.93</td>
<td>48.81</td>
<td>16.47</td>
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<td><strong>LSD, P=0.05</strong></td>
<td>NS</td>
<td>NS</td>
<td>5.299</td>
<td>4.547</td>
<td>5.516</td>
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<td>Harvest Dates</td>
<td>06/04/08</td>
<td>06/17/08</td>
<td>06/25/08</td>
<td>Total</td>
<td></td>
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<td>---------------------</td>
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<td>---------</td>
<td>---------</td>
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<tr>
<td>Control</td>
<td>9.1 lb</td>
<td>28.3 lb</td>
<td>14.7</td>
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<tr>
<td>Citronella</td>
<td>4.8</td>
<td>21.7</td>
<td>16.0</td>
<td>42.5</td>
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<tr>
<td>Citronella/Clove/Geranium</td>
<td>6.0</td>
<td>27.5</td>
<td>16.4</td>
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<tr>
<td>Clove/Rosemary</td>
<td>4.4</td>
<td>27.3</td>
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<td>48.9</td>
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<tr>
<td>Garlic Oil</td>
<td>5.7</td>
<td>30.0</td>
<td>18.2</td>
<td>54.0</td>
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<tr>
<td>Garlic/Citronella</td>
<td>7.7</td>
<td>23.1</td>
<td>20.1</td>
<td>50.9</td>
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<tr>
<td>Floating Row Cover</td>
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<td>16.1</td>
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<tr>
<td>Reflective Mulch</td>
<td>9.6</td>
<td>26.6</td>
<td>24.1</td>
<td>60.2</td>
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P=0.05     0.2547   0.1434   0.5756  0.0831
%CV=     47.43   27.01   35.38  17.20
LSD, P=0.05 4.702   9.969   9.402 12.625
LSD, P=0.10 10.450
Conclusions from 2010 Trial

• All mulches, plastic or kaolin clay, can reduce aphid flights into peppers.

• Silver reflective, Silver & Kaolin clay on canopy reduce thrips populations in plant canopy.

• Silver, Green & Red mulches increase plant growth of peppers.

• CMV was not a problem in 2010
Summary for the 3 year study

• Reducing aphid flights into pepper fields reduces the incidence of CMV.

• Reducing incidence of CMV increases yields.

• Plastic mulches, especially silver reflective, are very effective at reducing aphid and thrips populations in a field.

• Red and Green plastic mulch increase plant size and pepper yields.
Summary for the 3 year study

• Kaolin clay as a mulch may be less expensive, easier, and more environmentally sound method to reducing aphid populations.

• Botanical oils sold as insect repellents are not effective.
Thanks to:

Valprado Farms
  Mike Valpredo
  Rick Martinez
  Omar Martinez

California Pepper Commission