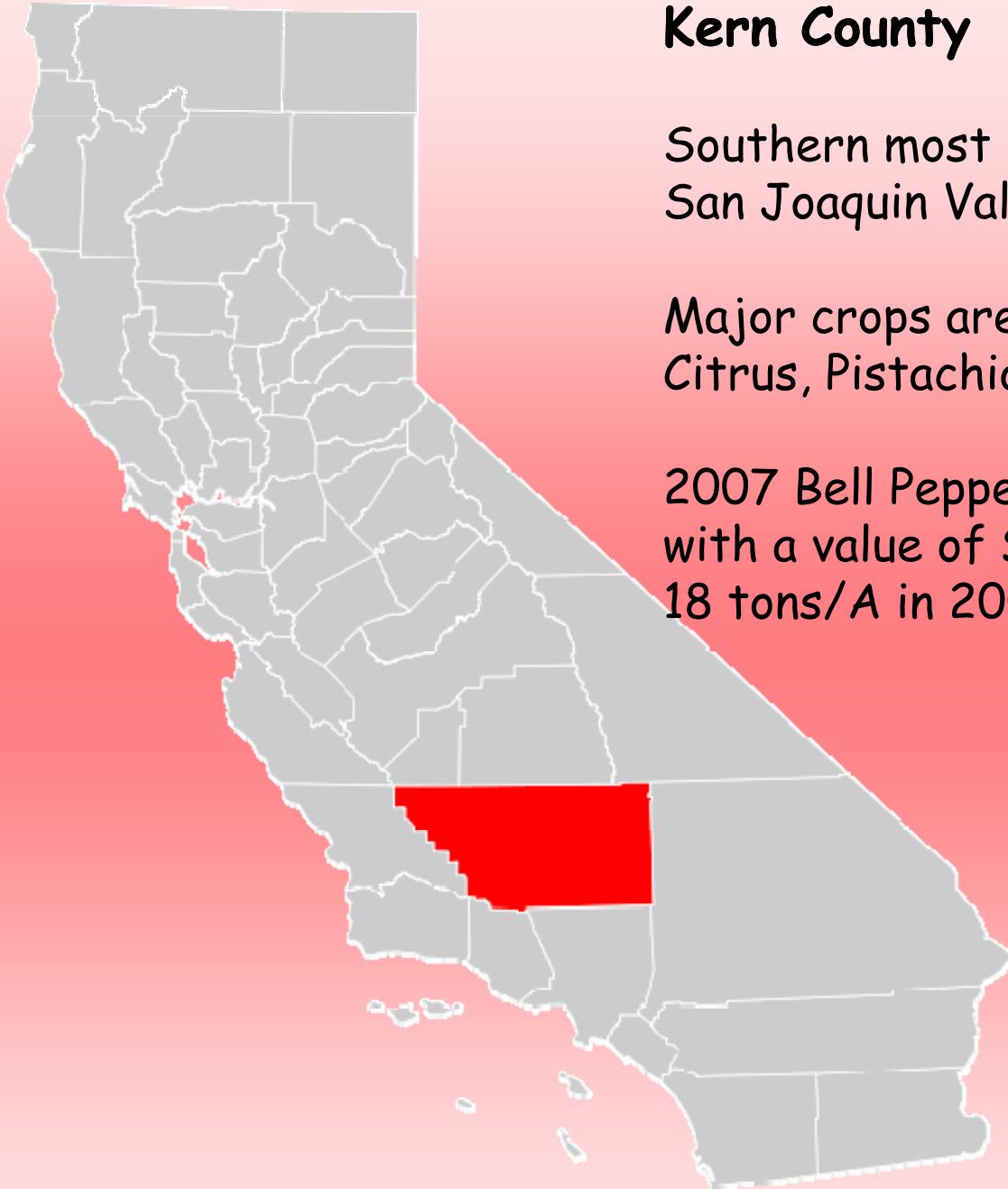


# Evaluation of Insect Repellents and Barriers as Methods to Control Cucumber Mosaic Virus of Bell Peppers

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## Kern County

Southern most county in the San Joaquin Valley

Major crops are Almonds, Table Grapes, Citrus, Pistachios, Carrots, Potatoes

2007 Bell Peppers accounted for 2,670 acres with a value of \$41.8 million. Average yield was 18 tons/A in 2007

# 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 worse than others
- The earlier it appears in the season, the more damage occurs
- Aphid-transmitted.







# Control of CMV

- Essentially none
- 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

- Aphids can probe and transmit the virus before they are killed by insecticides
- Goal is to prevent aphids from landing on plants

# How to Prevent Aphids from Landing on Plants?

- Insect repellents
  - Botanical oils that repel insects
  - Reflective mulches that repel insects
- Insect barriers
  - Floating row covers

# Time for a Field Experiment!

1. Control-bare ground
2. Citronella oil
3. Citronella oil, Clove oil, & Geranium oil
4. Clove oil & Rosemary oil
5. Garlic oil
6. Garlic oil & Citronella oil
7. Floating Row Cover
8. Silver Reflective Mulch

California Organic Fertilizers, Inc.  
7600 N. Ingram Ave., Suite 121,  
Fresno, CA 93711  
Tel: (800) 269-5690

Agribon AG15

Brite-N'up Silver Mulch 0.5 Mil  
Peaceful Valley Farm Supply  
P.O. Box 2209, 125 Clydesdale Court  
Grass Valley, CA 95945

# Field Trial

- Trial started at the time of transplanting
- Floating row cover and reflective mulch applied minutes after transplanting
- Botanical oils sprayed on a weekly basis beginning at the time of planting
- Yellow sticky cards placed just above canopy to monitor aphid flights and numbers on a weekly basis
- 2 trials conducted, 2<sup>nd</sup> trial w/o botanical oils. Both in a commercial, organic field







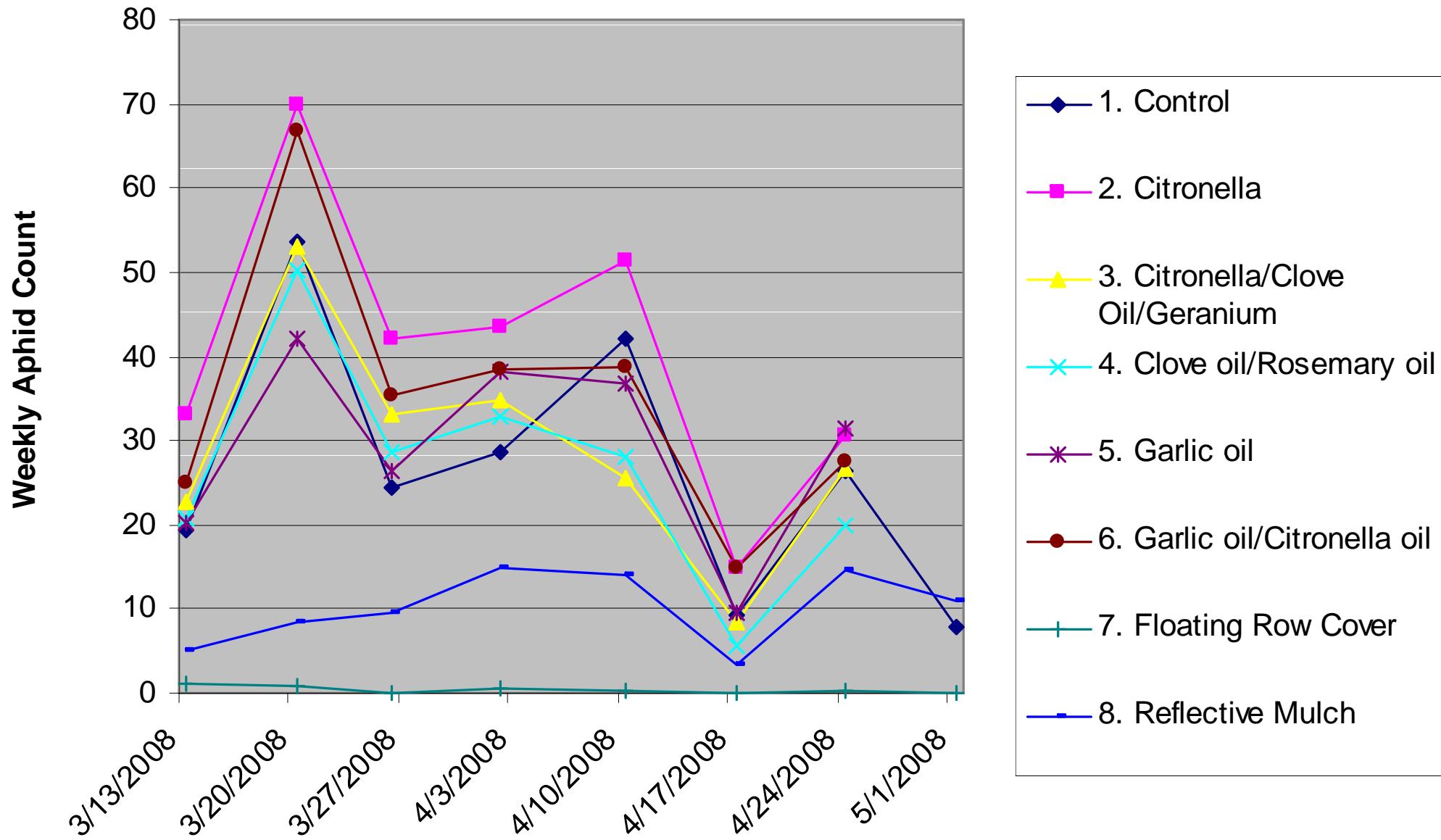
Floating Row Cover



Control

**Table 1. Aphid counts of botanical oils, reflective mulch and floating row cover in trial 1.**

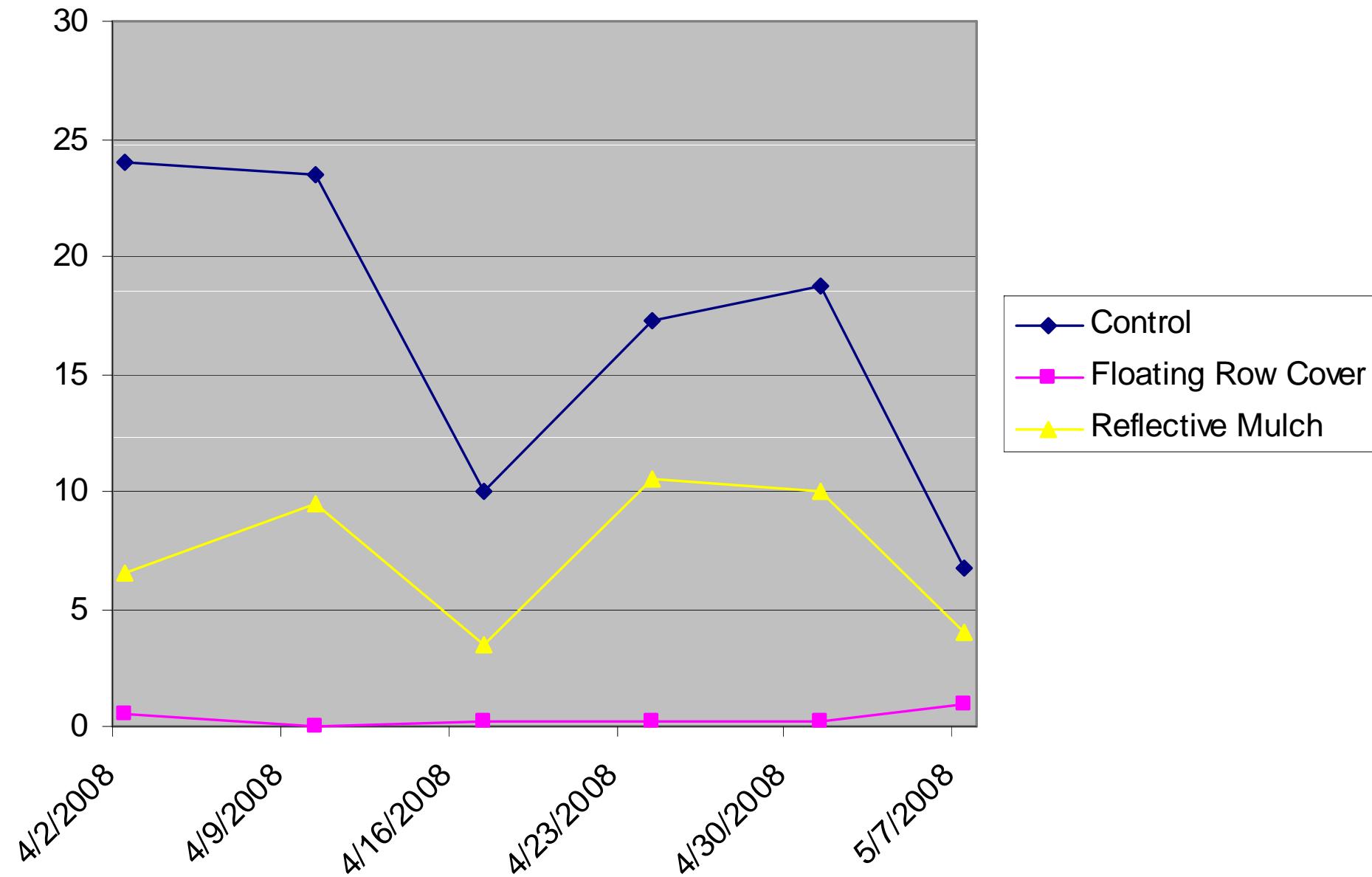
	3/13/08	3/20/08	3/26/08	4/02/08	4/10/08	4/17/08	4/24/08	5/01/08
1. Control	19.25 B	53.8 AB	24.5 BC	28.8 B	42.0 AB	9.3 AB	26.3 AB	7.8
2. Citronella	33.0 A	70.0 A	42.0 A	43.5 A	51.3 A	15.0 A	30.5 A	X
3. Citro/Clove/Geranium	22.8 AB	53.0 AB	33.3 AB	34.8 AB	25.5 CD	8.5 AB	26.8 AB	X
4. Clove/Rosemary	20.8 B	50.3 AB	28.5 AB	32.8 AB	28.0 BCD	5.8 BC	20.0 BC	X
5. Garlic Oil	20.3 B	42.0 B	26.5 B	38.3 AB	36.7 AB	9.5 AB	31.5 A	X
6. Garlic/Citronella	25.0 AB	66.8 AB	35.5 AB	38.5 AB	38.8 ABC	14.8 A	27.5 AB	X
7. Floating Row Cover	1.0 C	0.8 C	0.0 D	0.5 D	0.3	E 0.0 C	0.3 D	0.0
8. Reflective Mulch	5.0 C	8.5 C	9.5 D	15.0 C	14.0	DE 3.5 BC	14.5 C	11.0
P=0.05	0.00001	0.00001	0.0002	0.0000	0.0000	0.0030	0.0000	
%CV=	39.77	40.99	42.17	28.17	34.71	58.35	27.94	
LSD, P=0.05	10.745	25.995	15.482	12.012	15.490	7.106	9.103	



**Table 2. Aphid counts of reflective mulch, floating row cover in trial 2**

	<b>4/02/08</b>	<b>4/10/08</b>	<b>4/17/08</b>	<b>4/24/08</b>	<b>05/01/08</b>	<b>05/07/08</b>
<b>1. Control</b>	<b>24.0 A</b>	<b>23.5 A</b>	<b>10.0 A</b>	<b>17.3 A</b>	<b>18.8 A</b>	<b>6.8 A</b>
<b>2. Floating Row Cover</b>	<b>0.5 B</b>	<b>0.0 C</b>	<b>0.3 B</b>	<b>0.3 B</b>	<b>0.3 C</b>	<b>1.0 B</b>
<b>3. Reflective Mulch</b>	<b>6.5 B</b>	<b>9.5 B</b>	<b>3.5 B</b>	<b>10.5 A</b>	<b>10.0 B</b>	<b>4.0 A</b>
<b>P=0.05</b>	<b>0.004</b>	<b>0.002</b>	<b>0.0012</b>	<b>0.0049</b>	<b>0.0052</b>	<b>0.0072</b>
<b>%CV=</b>	<b>38.30</b>	<b>31.78</b>	<b>43.18</b>	<b>47.882</b>	<b>50.59</b>	<b>41.48</b>
<b>LSD, P=0.05</b>	<b>6.848</b>	<b>6.049</b>	<b>3.424</b>	<b>7.732</b>	<b>8.462</b>	<b>2.811</b>

### Weekly Aphid Counts





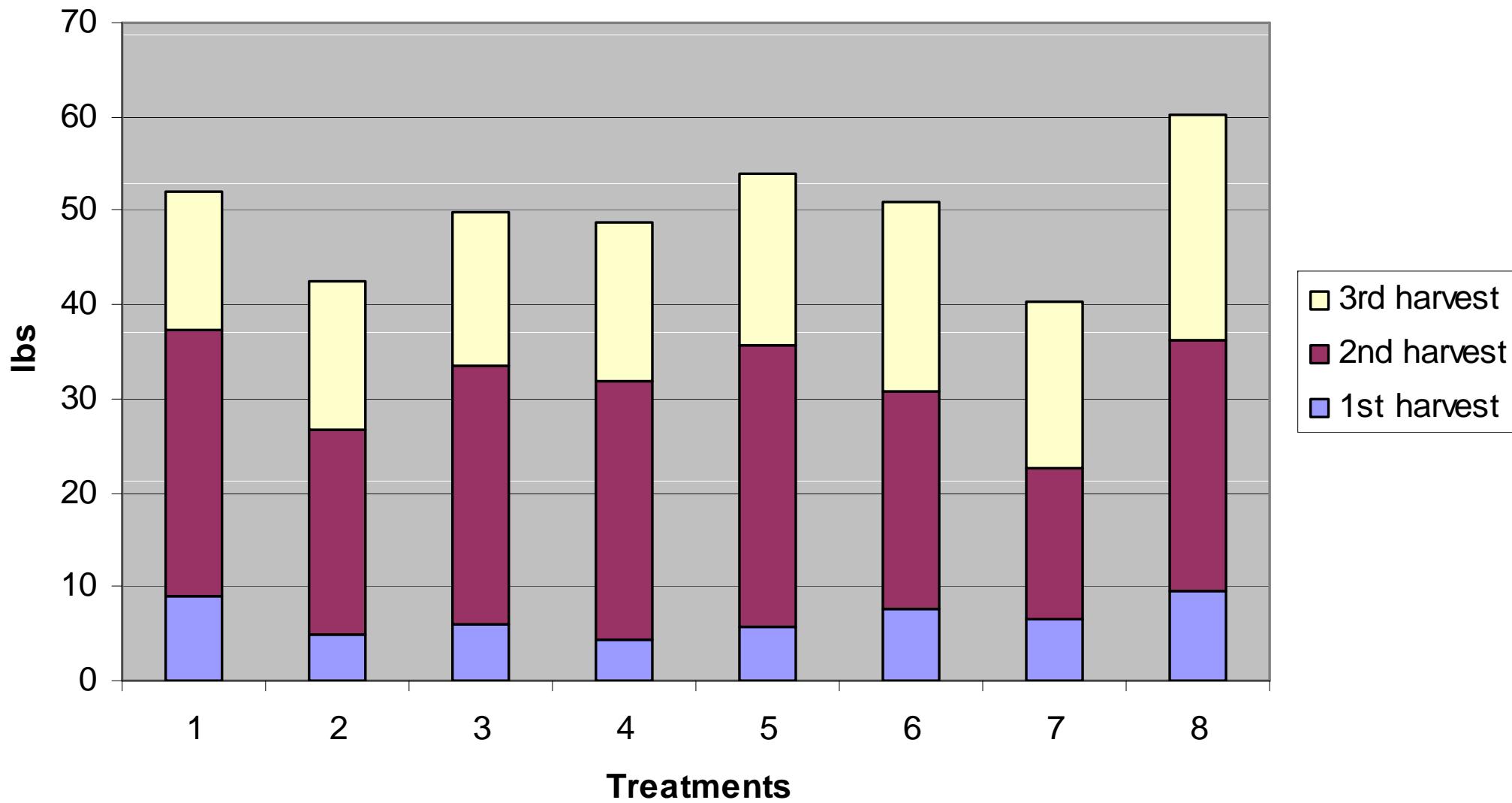
## Harvest Data

- Total weight
- Weight for each grade category
- Total number peppers
- Number peppers for each grade category

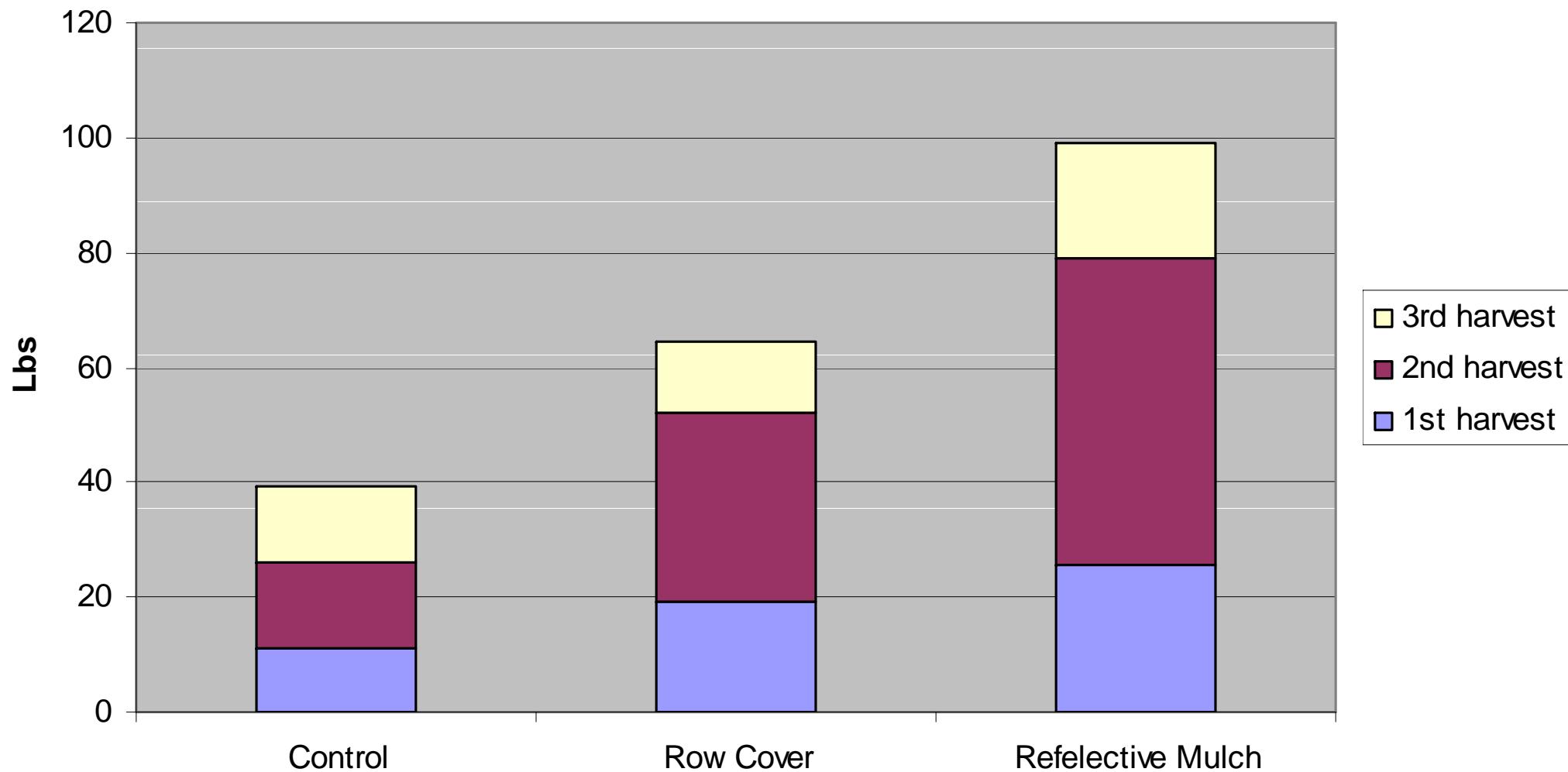
	<u>Harvest Dates</u>			
	<u>06/04/08</u>	<u>06/17/08</u>	<u>06/25/08</u>	<u>Total</u>
1. Control	9.1 lb	28.3 lb	14.7 lb	52.2 ABC
2. Citronella	4.8	21.7	16.0	42.5 CD
3. Citronella/Clove/Geranium	6.0	27.5	16.4	49.9 ABCD
4. Clove/Rosemary	4.4	27.3	17.1	48.9 BCD
5. Garlic Oil	5.7	30.0	18.2	54.0 AB
6. Garlic/Citronella	7.7	23.1	20.1	50.9 ABC
7. Floating Row Cover	6.5	16.1	17.7	40.4 D
8. <u>Reflective Mulch</u>	<u>9.6</u>	<u>26.6</u>	<u>24.1</u>	<u>60.2 A</u>
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

	<u>Harvest Dates</u>			<u>Total</u>
	<u>06/20/08</u>	<u>07/02/08</u>	<u>07/17/08</u>	
1. Control	11.1	15.1 B	13.2 B	39.4 B
2. Floating Row Cover	19.3	33.0 AB	12.2 B	64.5 AB
3. <u>Reflective Mulch</u>	25.6	53.4 A	20.0 A	99.0 A
P=0.05	0.2781	0.0193	0.0557	0.0386
%CV=	61.67	39.56	25.55	36.50
LSD, P=0.05	19.9	23.2	6.7	42.7

## Yield Totals after 3 Harvests of 40 feet of Row

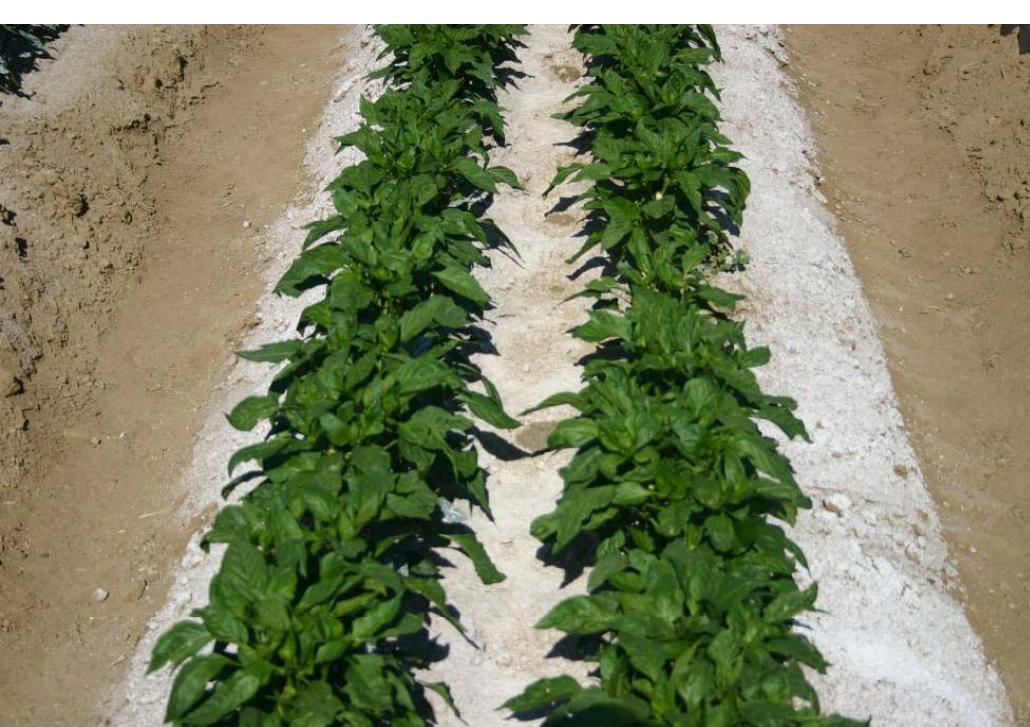


## Total Yield after 3 Harvests per 40 ft plot



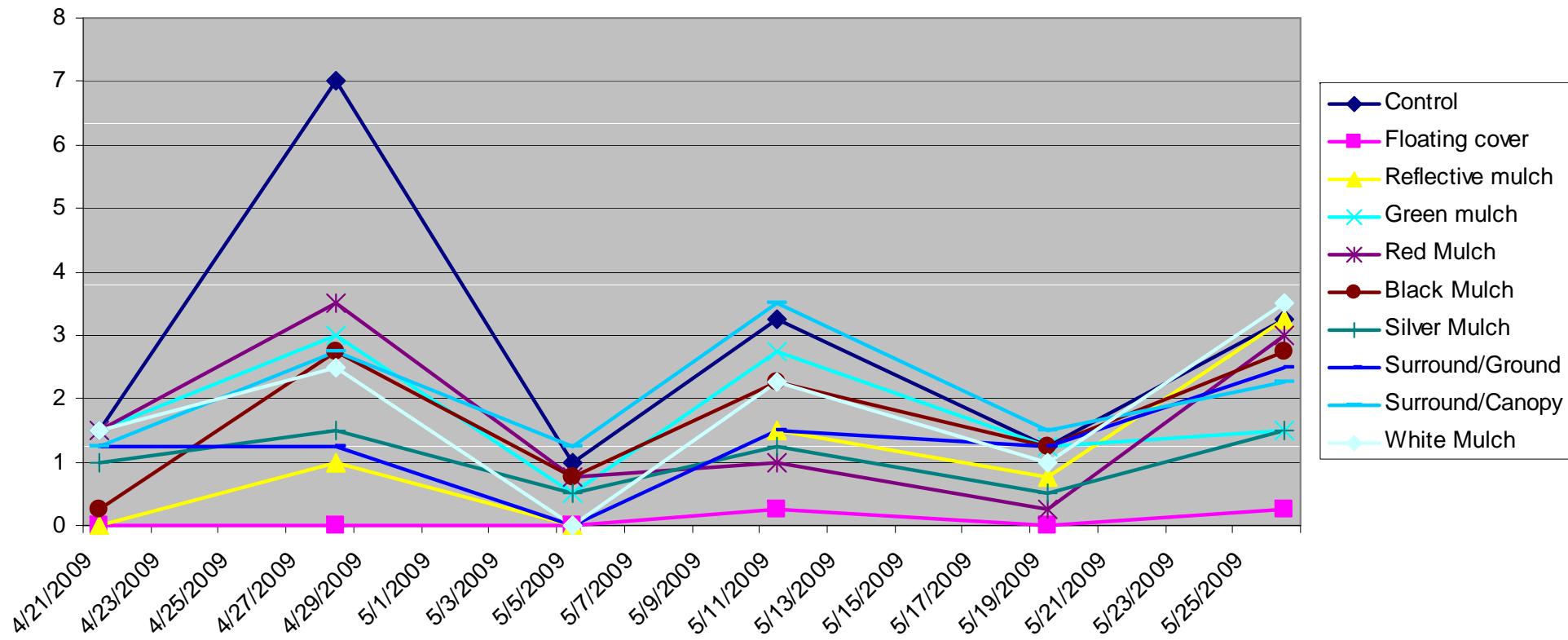
# 2009 Pepper Trial

1. Non-treated Control
2. Floating Row Cover
3. Silver Reflective Mulch
4. Green Mulch
5. Red Mulch
6. Black Mulch
7. Silver Mulch
8. Surround Sprayed on beds as a Reflective Mulch
9. Surround sprayed onto plant canopy
10. White Mulch

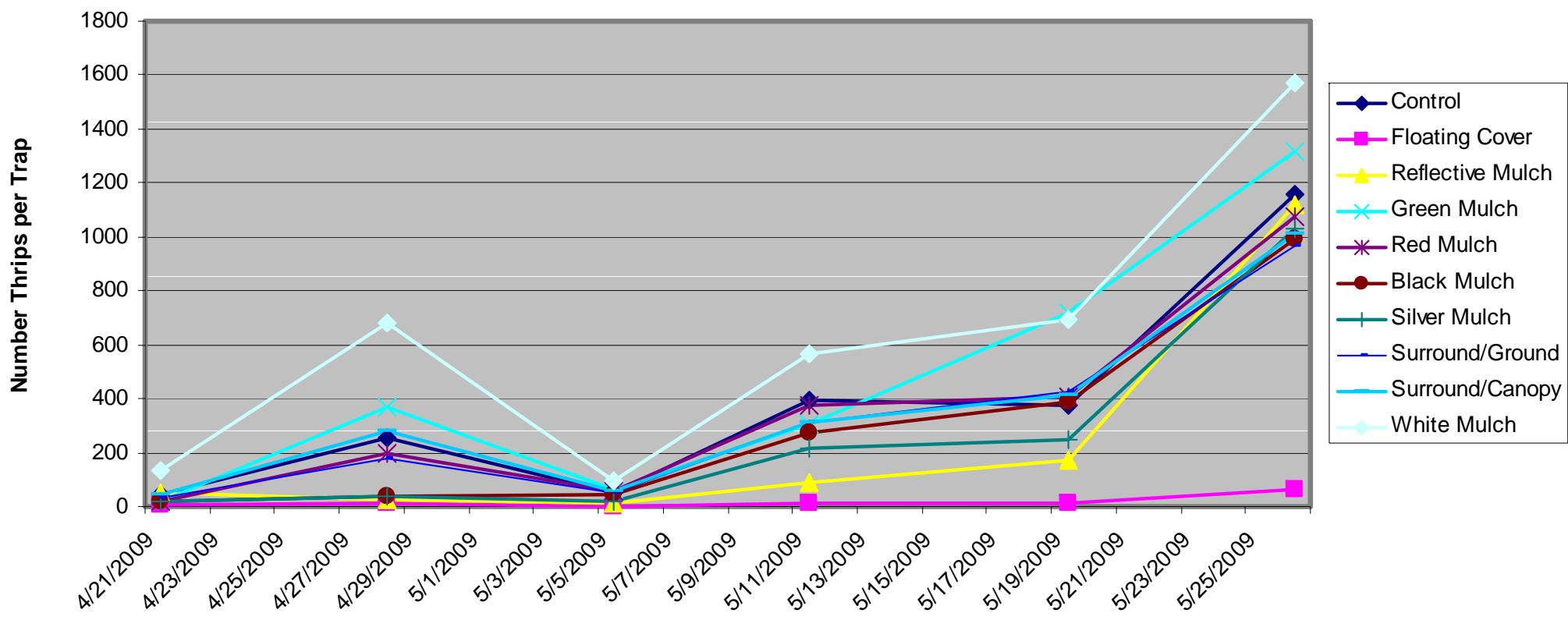


### Weekly Aphid Counts 2009

Number Aphids per Trap



## Weekly Thrip Counts 2009



# Harvest Weights (lbs)

	<b>BB's Marketable Wt</b>	<b>Cull Wt</b>	<b>Total Marketable Wt</b>	<b>Total Processing Wt</b>	<b>Total Wt.</b>
<b>1. Control</b>	<b>1.14</b>	<b>0.12</b>	<b>16.61 BC</b>	<b>5.53 BC</b>	<b>22.14 BC</b>
<b>2. Row Cover</b>	<b>1.16</b>	<b>0.00</b>	<b>4.91 D</b>	<b>2.66 C</b>	<b>7.58 D</b>
<b>3. Silver Reflective Mulch</b>	<b>1.11</b>	<b>0.00</b>	<b>16.49 BC</b>	<b>4.56 C</b>	<b>21.04 C</b>
<b>4. Green Mulch</b>	<b>0.76</b>	<b>0.41</b>	<b>18.26 ABC</b>	<b>9.63 AB</b>	<b>27.89 A</b>
<b>5. Red Mulch</b>	<b>0.69</b>	<b>0.76</b>	<b>22.68 A</b>	<b>6.49 ABC</b>	<b>29.16 A</b>
<b>6. Black Mulch</b>	<b>1.15</b>	<b>0.59</b>	<b>20.33 AB</b>	<b>5.09 BC</b>	<b>25.11 ABC</b>
<b>7. Silver Mulch</b>	<b>0.64</b>	<b>0.10</b>	<b>18.60 ABC</b>	<b>5.51 BC</b>	<b>24.11 ABC</b>
<b>8. Surround Mulch</b>	<b>0.55</b>	<b>0.33</b>	<b>15.20 BC</b>	<b>10.81 A</b>	<b>26.66 AB</b>
<b>9. Surround Whitewash</b>	<b>0.87</b>	<b>0.26</b>	<b>17.80 ABC</b>	<b>6.75 ABC</b>	<b>24.55 ABC</b>
<b>10. White Mulch</b>	<b>0.95</b>	<b>0.26</b>	<b>14.73 C</b>	<b>7.08 ABC</b>	<b>21.80 BC</b>
<b>P=0.05</b>	<b>0.5772</b>	<b>0.2142</b>	<b>0.0001</b>	<b>0.0454</b>	<b>0.0000</b>
<b>% CV</b>	<b>56.11</b>	<b>146.59</b>	<b>21.93</b>	<b>48.81</b>	<b>16.47</b>
<b>LSD, P=0.05</b>	<b>NS</b>	<b>NS</b>	<b>5.299</b>	<b>4.547</b>	<b>5.516</b>

# Conclusions

- Botanical oils do not repel aphids
- Reflective mulches do an excellent job of repelling aphids
- Floating row covers essentially allow zero aphids to reach plants.
- Reduction of aphids from landing on plants results in less CMV.
- Less CMV results in increased yields of peppers.
- Silver Mulch, Silver Reflective Mulch, and Floating Row Cover reduce thrip counts. Other colors increase thrip counts.

# Thanks to

- Valpredo Farms
  - Don Valpredo, Mike Valpredo, Rick Martinez, Omar Martinez
- California Organic Fertilizer
- California Pepper Commission