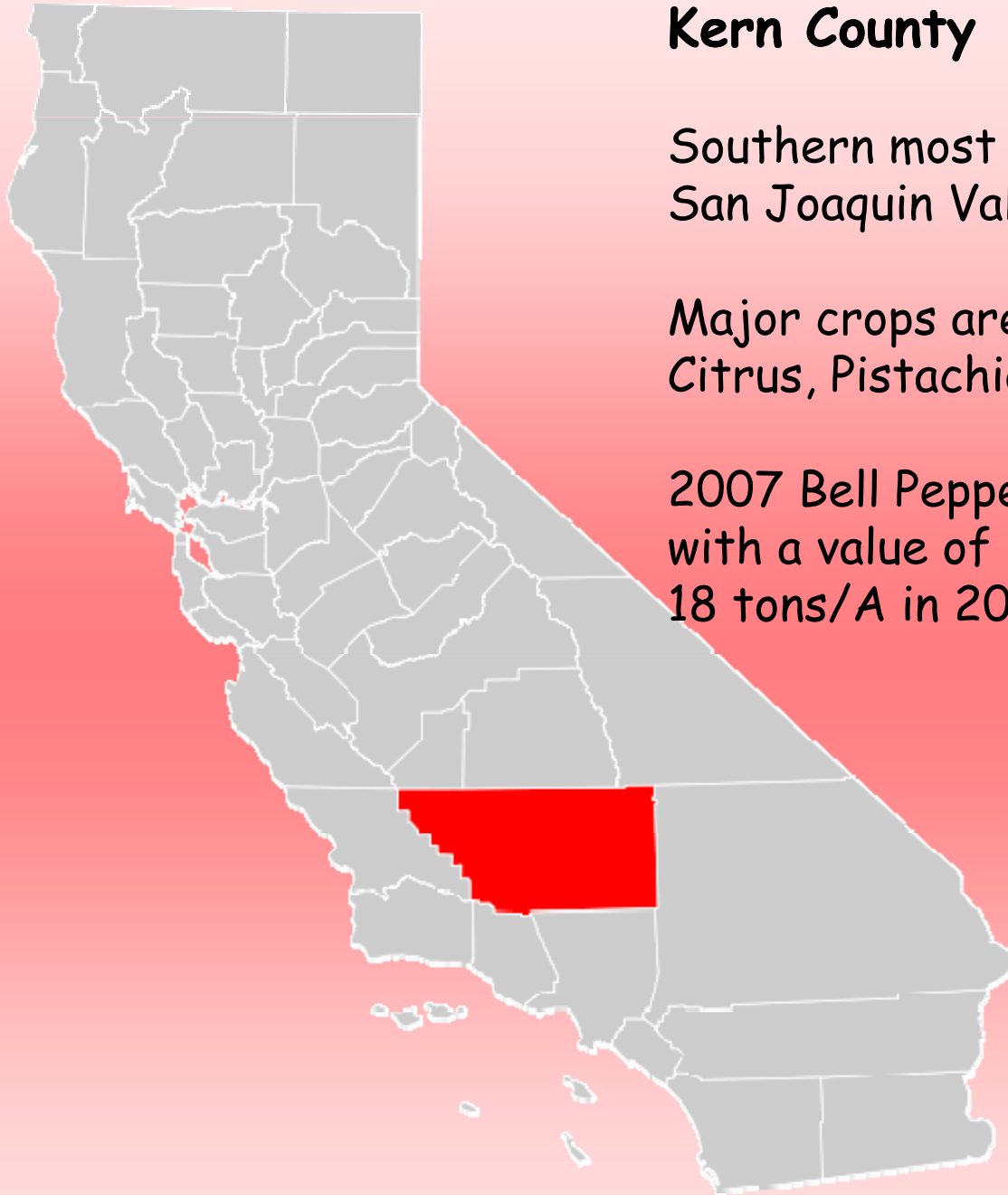


Evaluation of Insect Repellents and Barriers as Methods to Control Cucumber Mosaic Virus of Bell Peppers

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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, 2nd 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	

Weekly Aphid Count

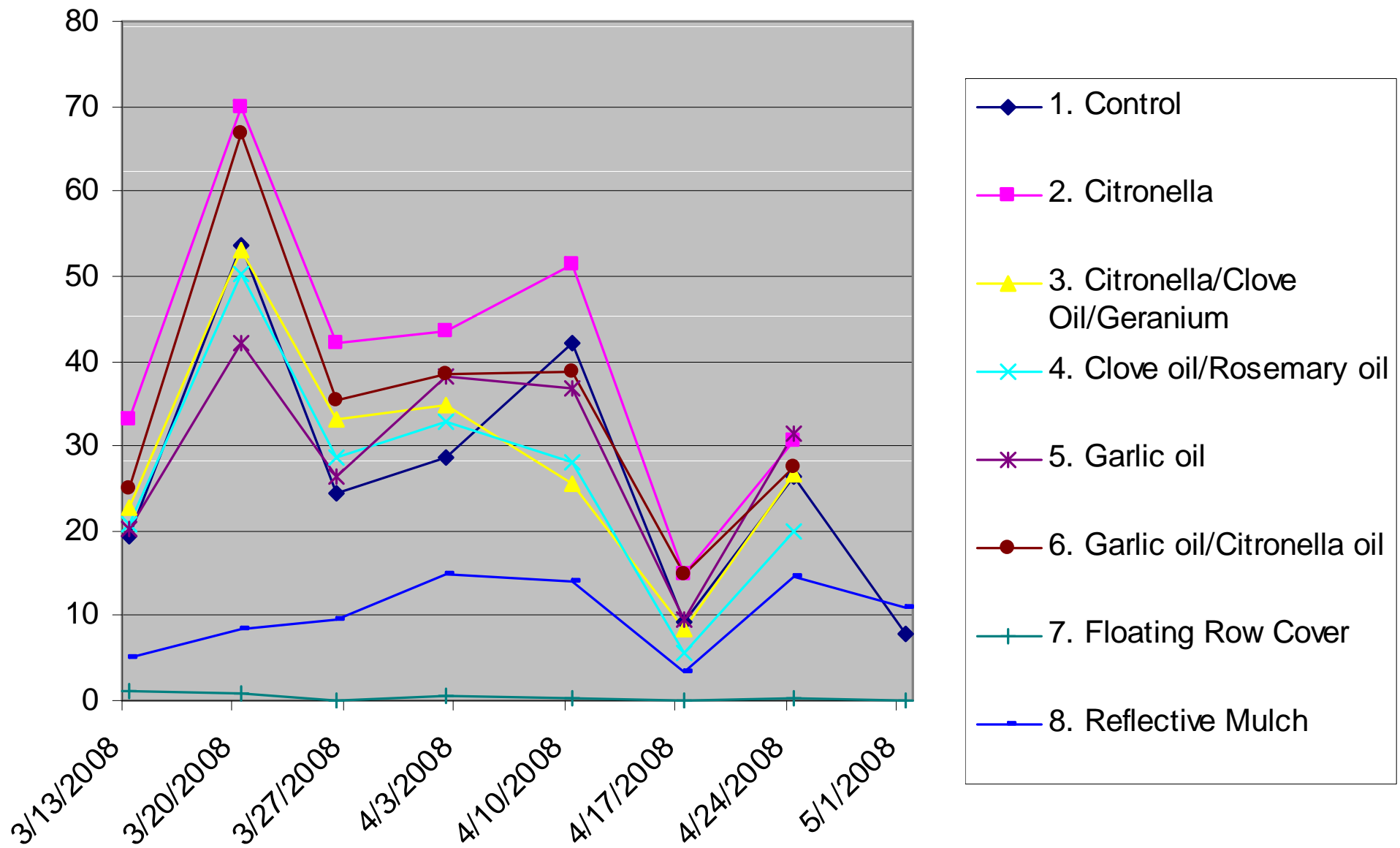
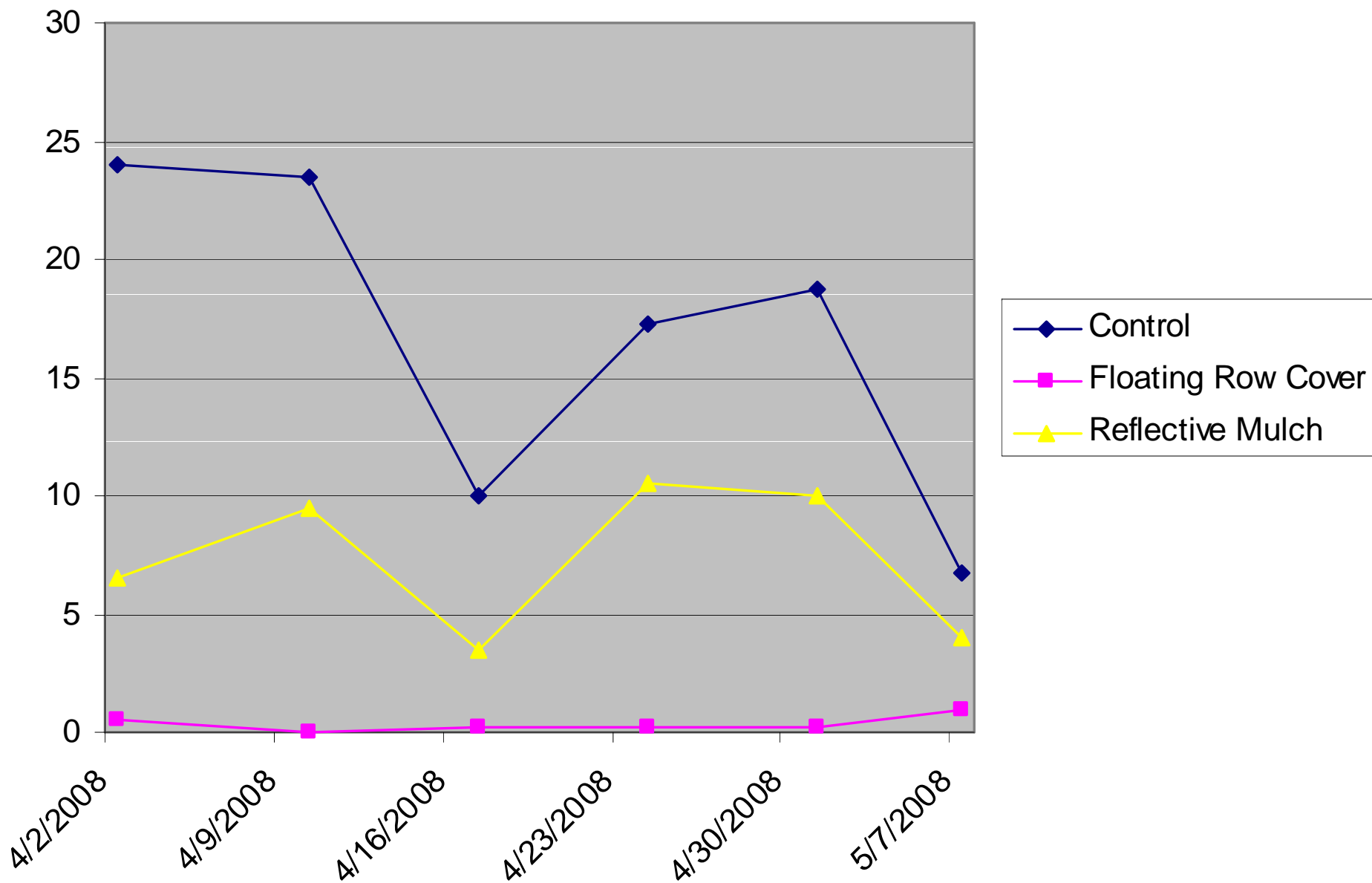


Table 2. Aphid counts of reflective mulch, floating row cover in trial 2

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

Weekly Aphid Counts





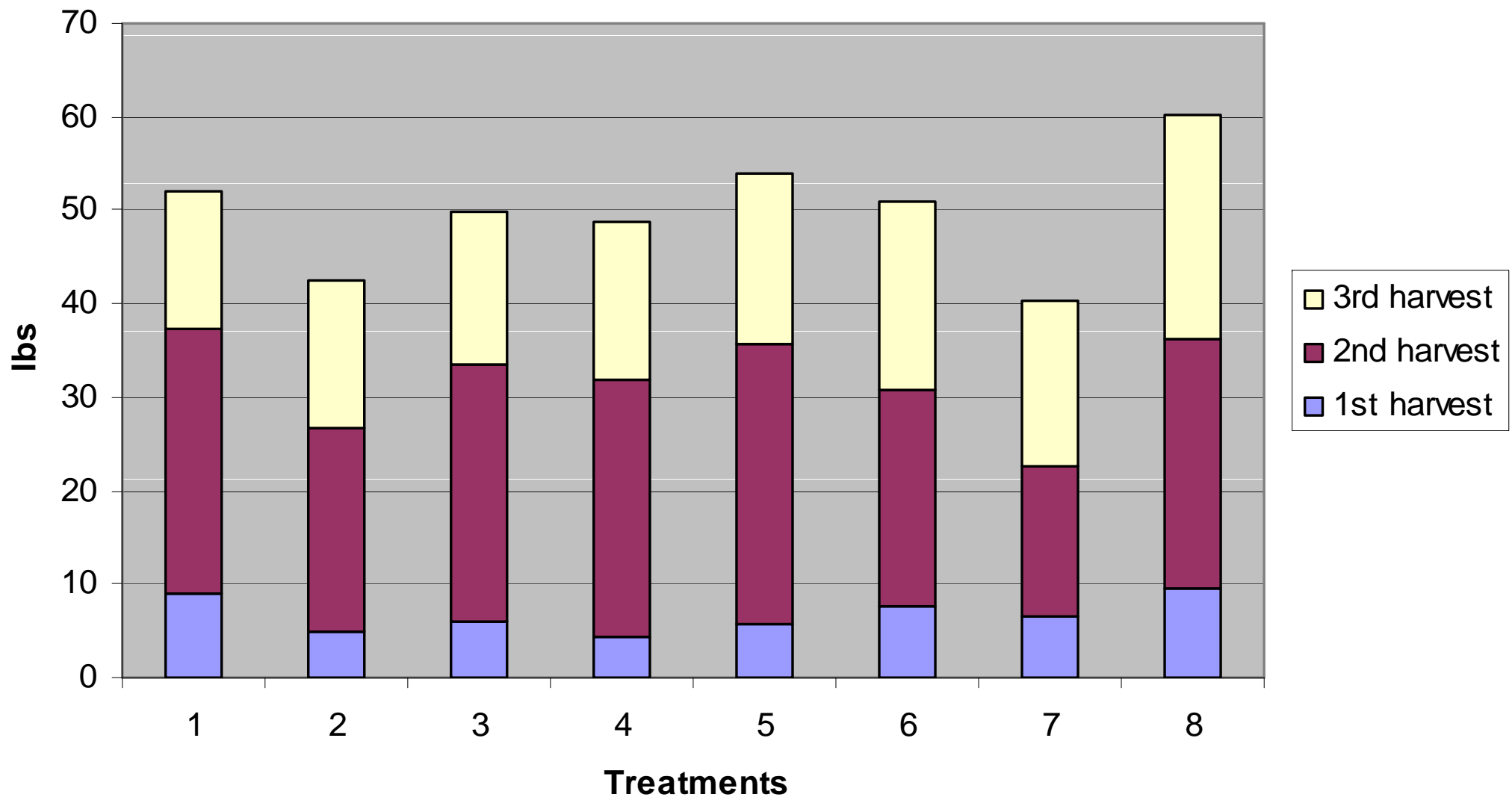
Harvest Data

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

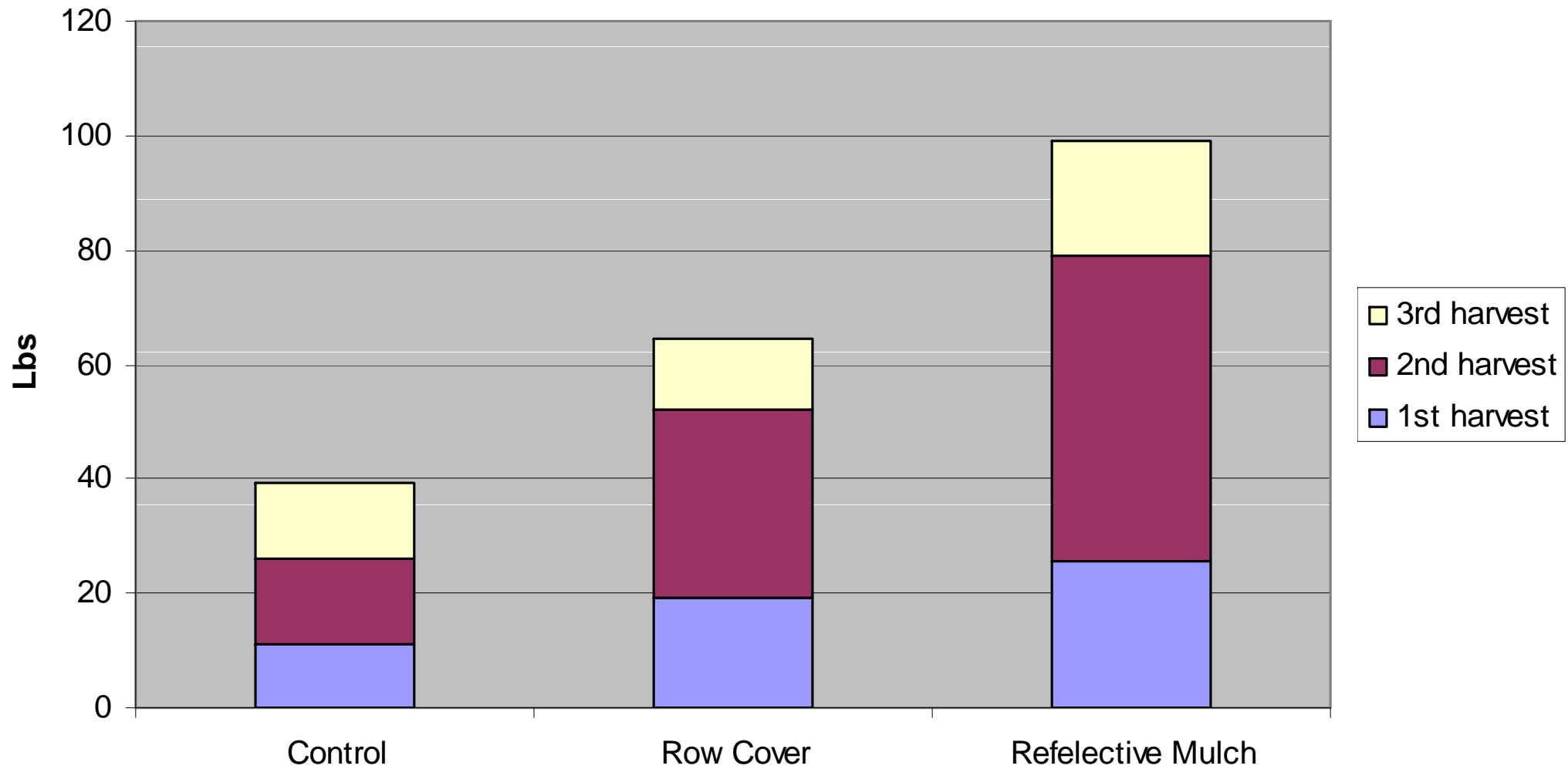
	<u>Harvest Dates</u>			
	<u>06/04/08</u>	<u>06/17/08</u>	<u>06/25/08</u>	<u>Total</u>
1. Control	9.1 lb	28.3 lb	14.7 lb	52.2 ABC
2. Citronella	4.8	21.7	16.0	42.5 CD
3. Citronella/Clove/Geranium	6.0	27.5	16.4	49.9 ABCD
4. Clove/Rosemary	4.4	27.3	17.1	48.9 BCD
5. Garlic Oil	5.7	30.0	18.2	54.0 AB
6. Garlic/Citronella	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>	9.6	26.6	24.1	60.2 A
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>06/20/08</u>	<u>07/02/08</u>	<u>07/17/08</u>	<u>Total</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

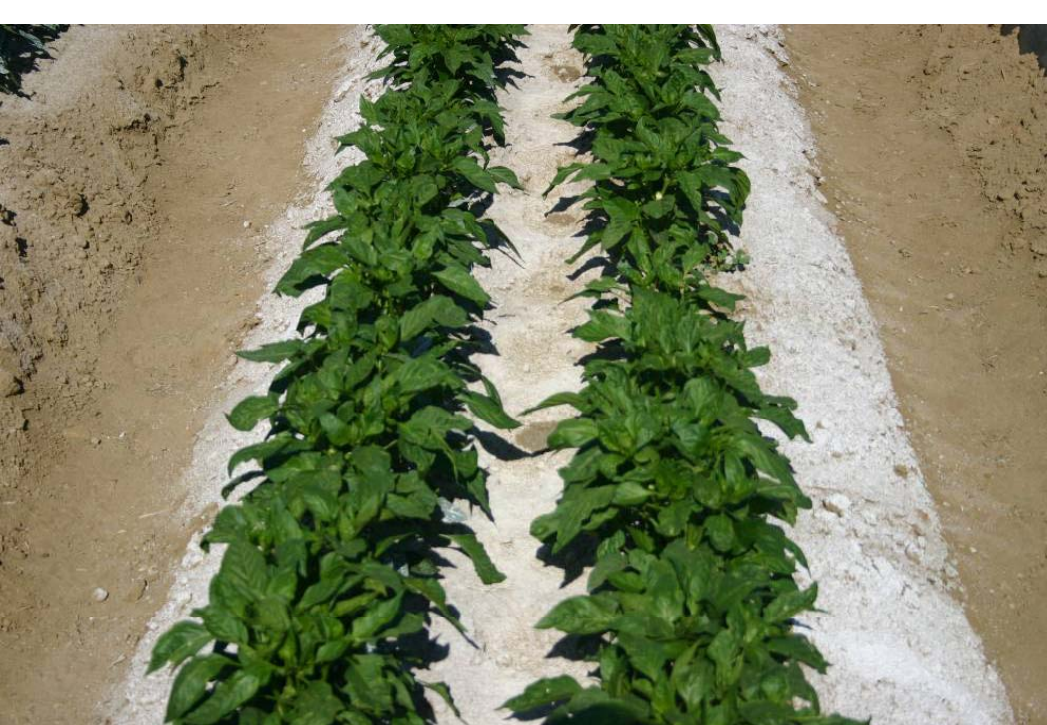


Total Yield after 3 Harvests per 40 ft plot

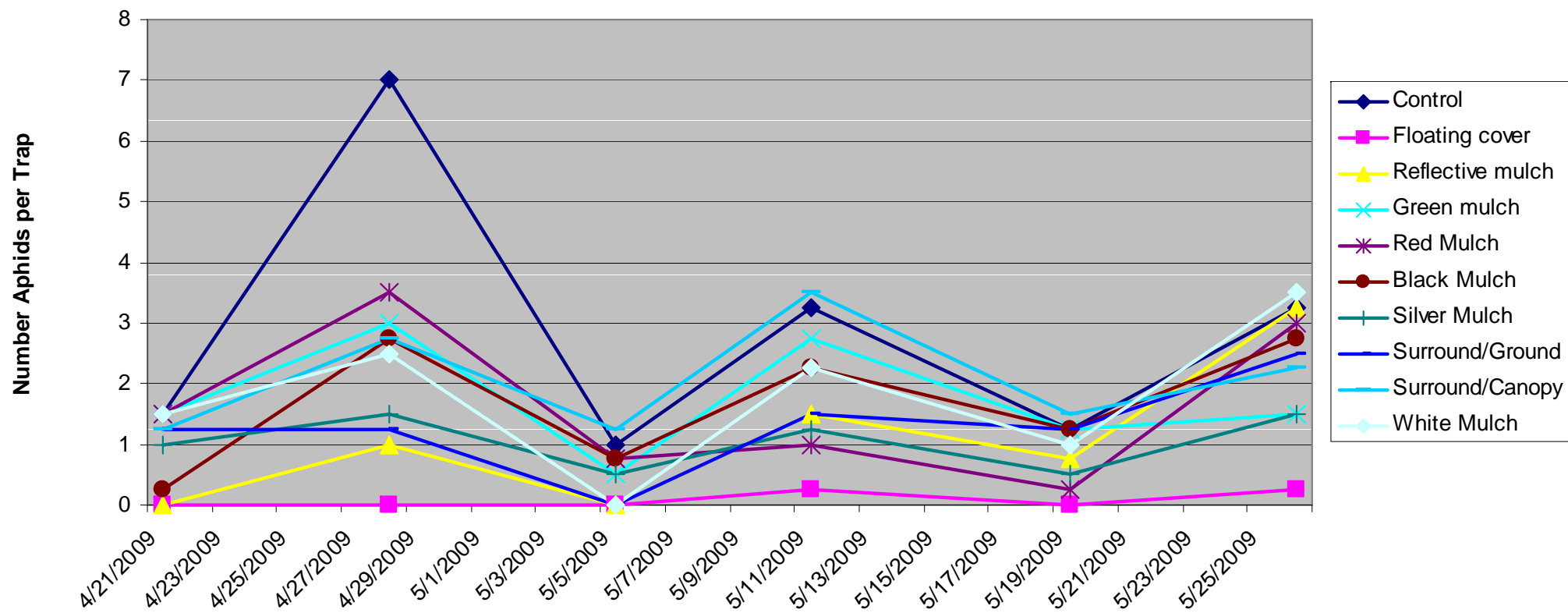


2009 Pepper Trial

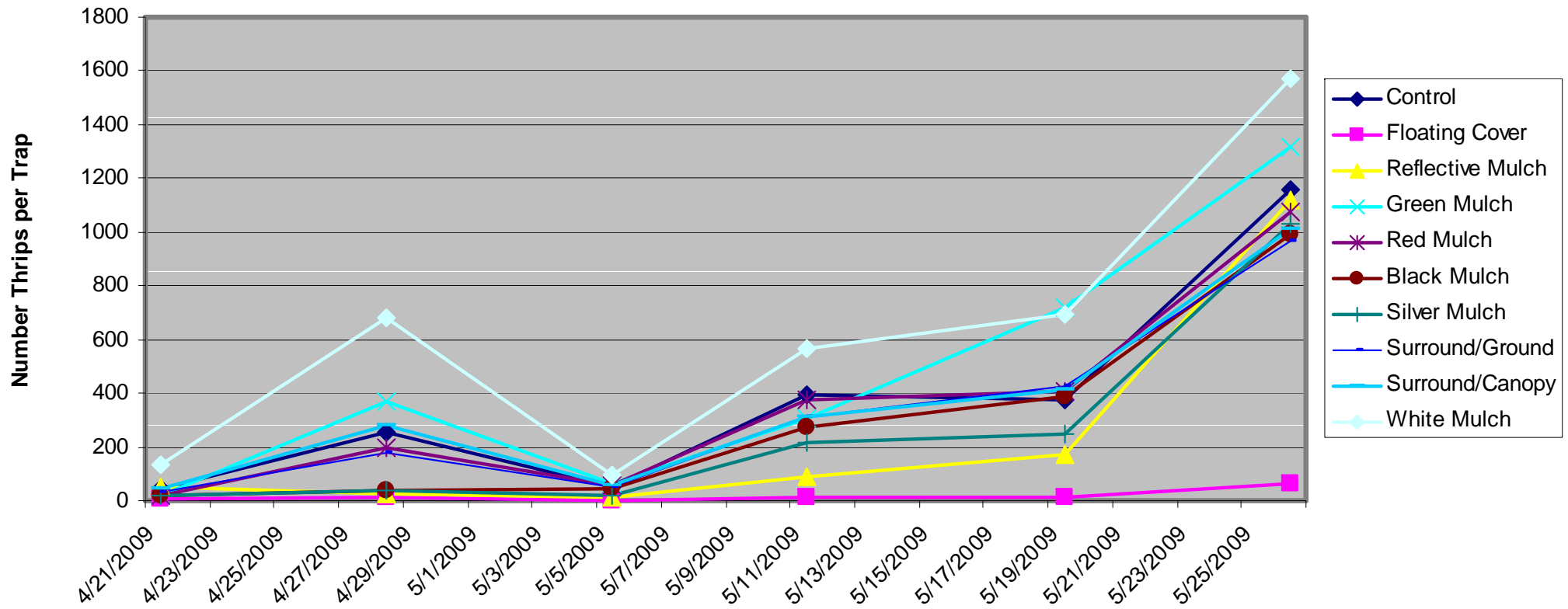
1. Non-treated Control
2. Floating Row Cover
3. Silver Reflective Mulch
4. Green Mulch
5. Red Mulch
6. Black Mulch
7. Silver Mulch
8. Surround Sprayed on beds as a Reflective Mulch
9. Surround sprayed onto plant canopy
10. White Mulch



Weekly Aphid Counts 2009



Weekly Thrip Counts 2009



Harvest Weights (lbs)

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

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