



Navel Orangeworm: Factors Affecting  
Survival, Pesticide Efficacy, and  
Development  
**Joel P. Siegel, USDA/ARS**

**7 Years of  
Study**

**What Gives?**



Navel orangeworm: A Great  
American Success Story

**A Supreme Scavenger,  
Evolved in a totally  
different system**

**Thrives on Mold,  
Can Handle Aflatoxins  
Inherently Variable**

# What is the longest time to emerge?

Mummy pistachios that were baked at 180°F overnight, infested and held at 81°F

4,350 DD°F--174 Days

Peak at 4,850 DD°F-194 Days

**How Quick?**

**As fast as 250-300 DD**

**Nuts are a  
changing resource**

**As food quality  
decreases, development  
time increases**

**Food Quality**

**Degree Days/Temperature**

**Genetics**

# **Degree Days are NOT Constant**

**MORE** from mid Autumn through  
Early June than calculated

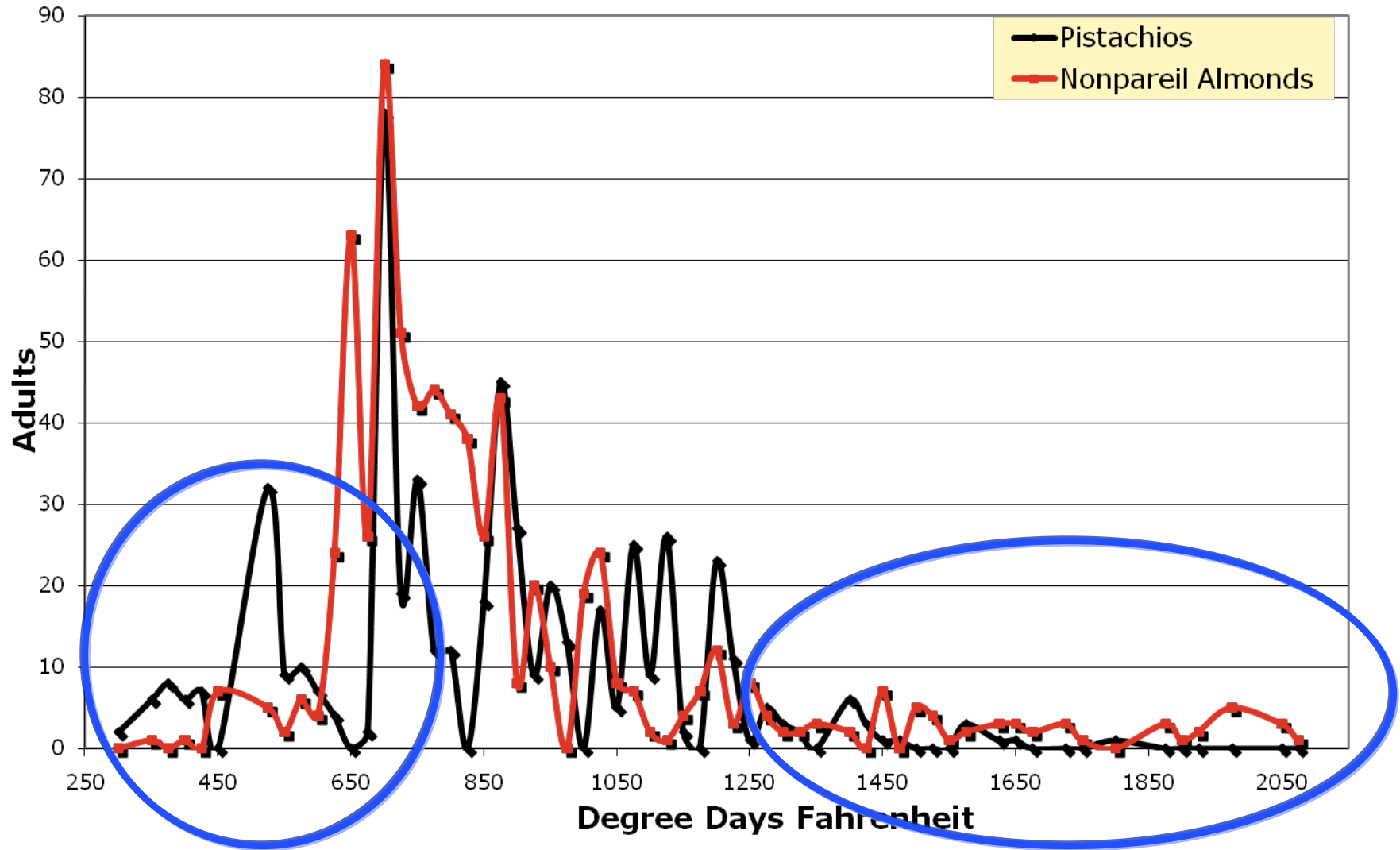
**LESS** throughout the summer than  
calculated

**Pistachios**

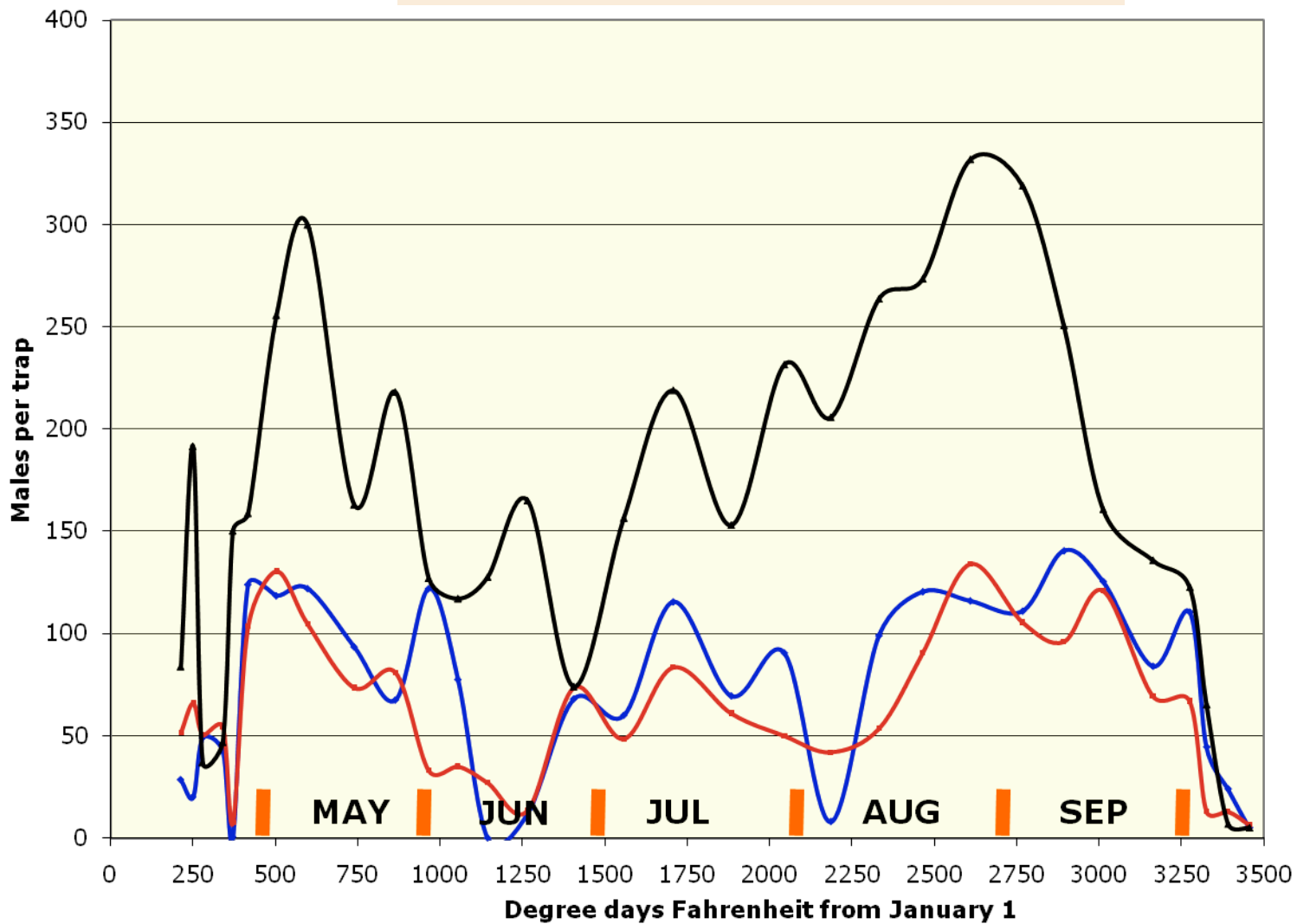
**vs.**

**Almonds**

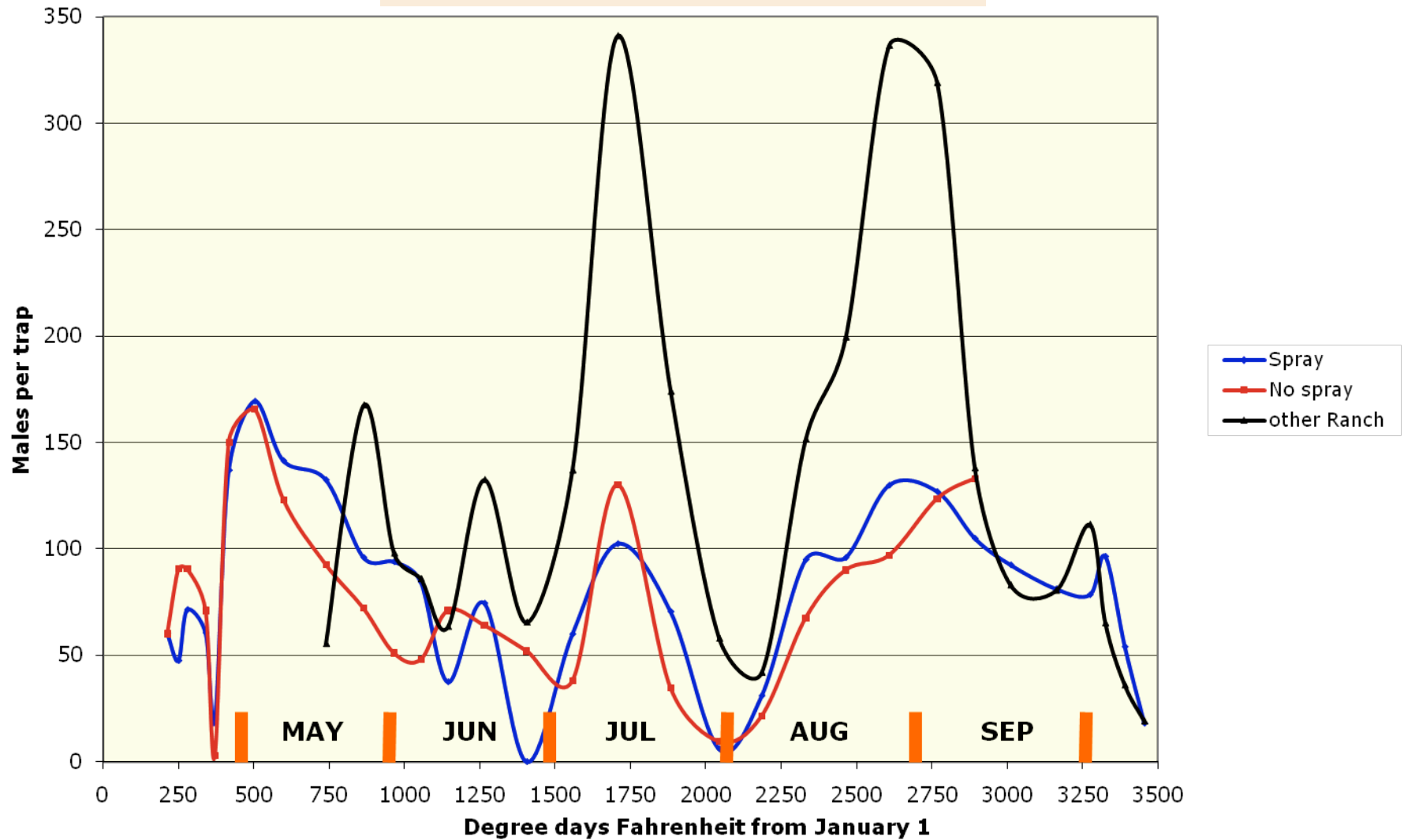
## Emergence from Nonpareil Almonds vs. Kerman Pistachios



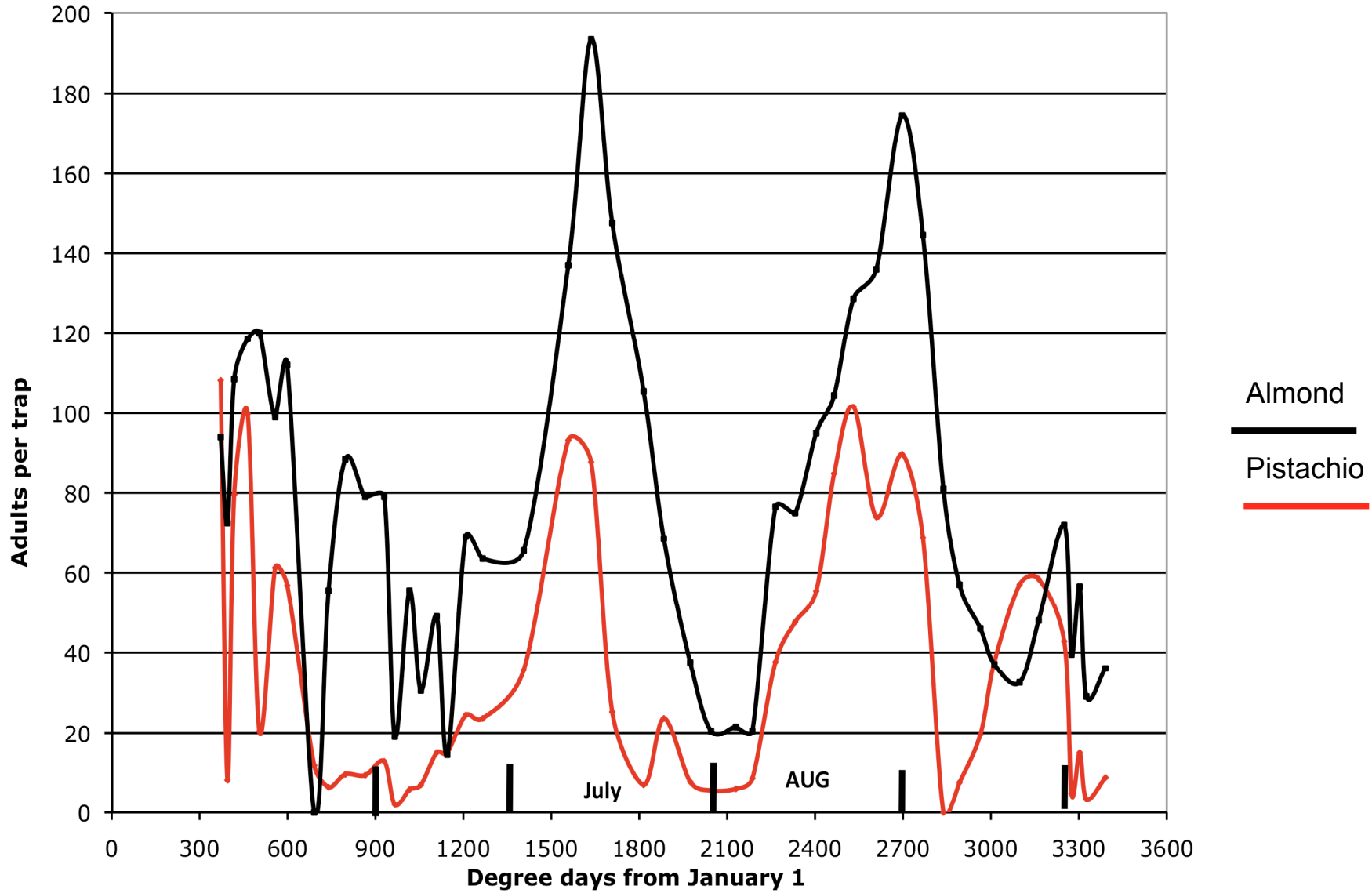
# Pistachios



# Almonds

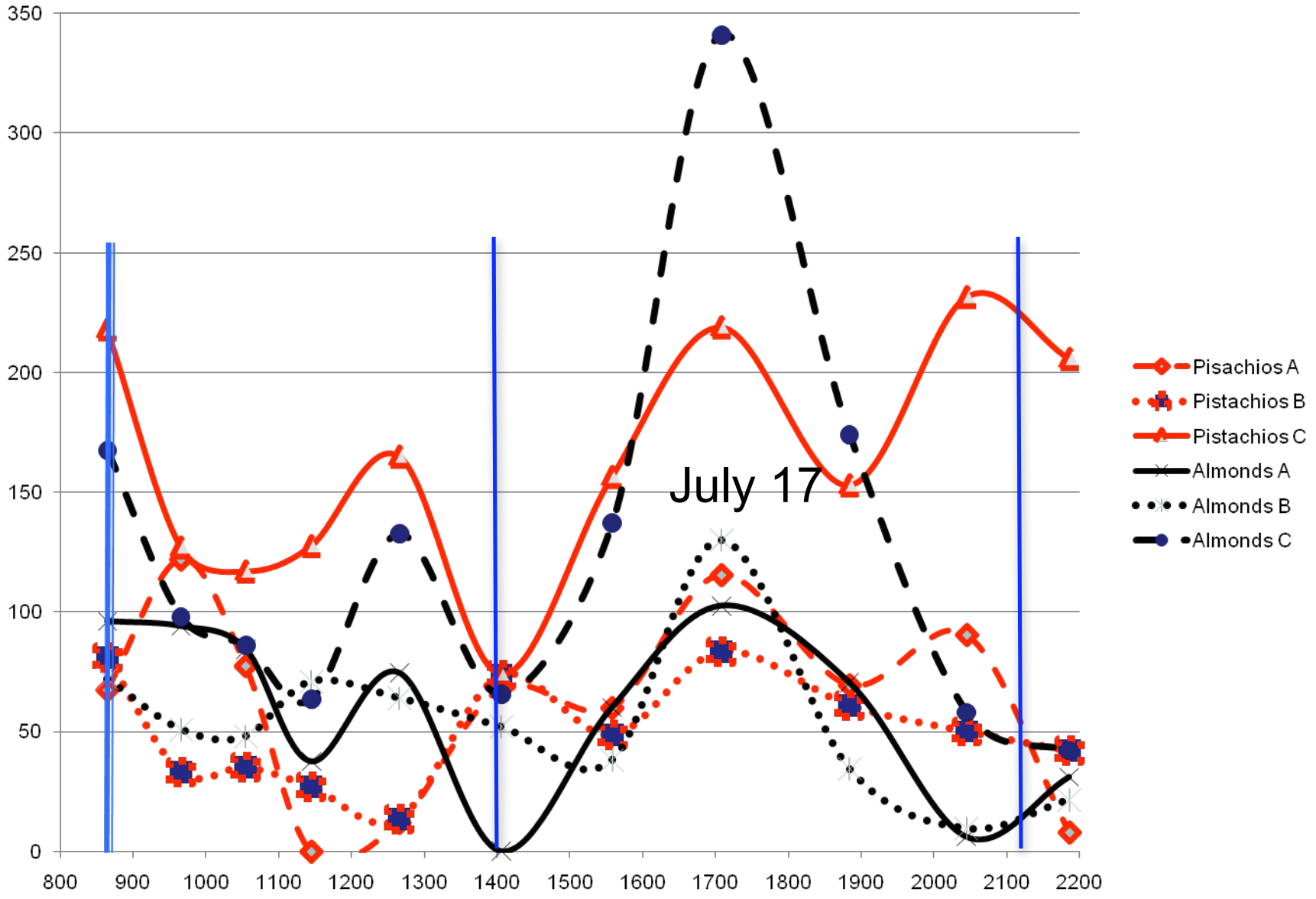


# Almond and Pistachio



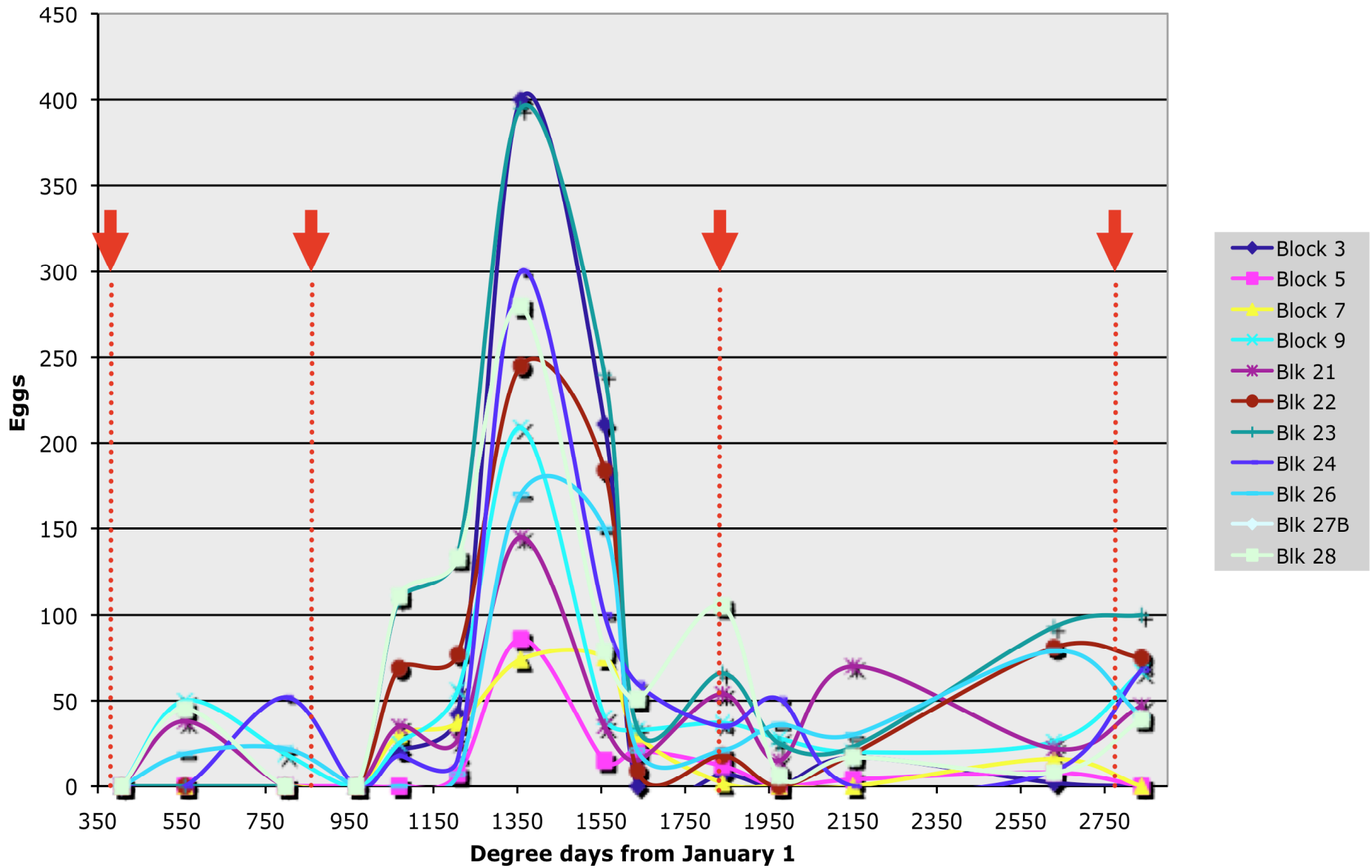
**But peaks in both  
coincide**

# Madera 2009



**constant  
Pressure**

# AgriWorld Egg Trapping

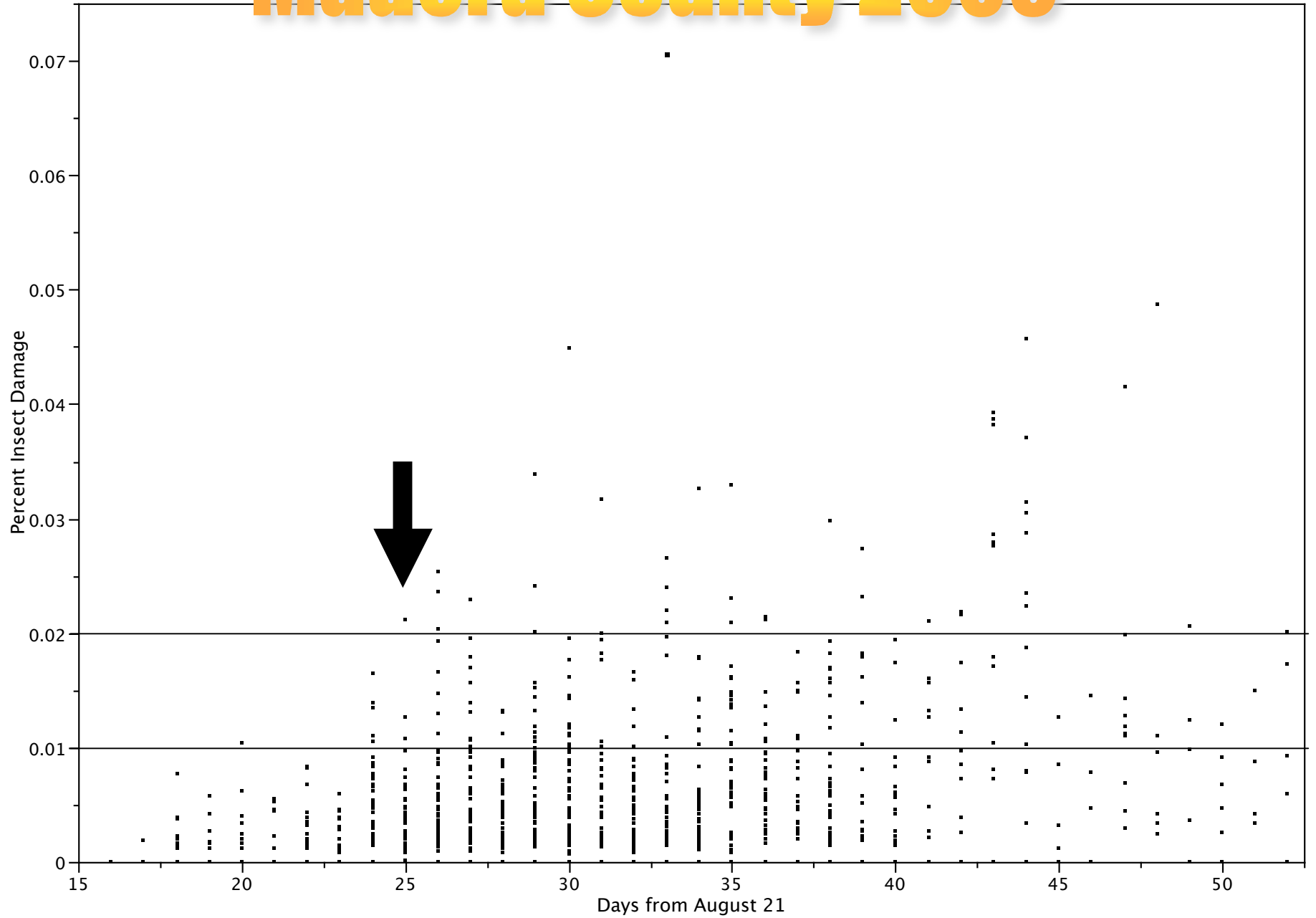


**Harvest of 2009**

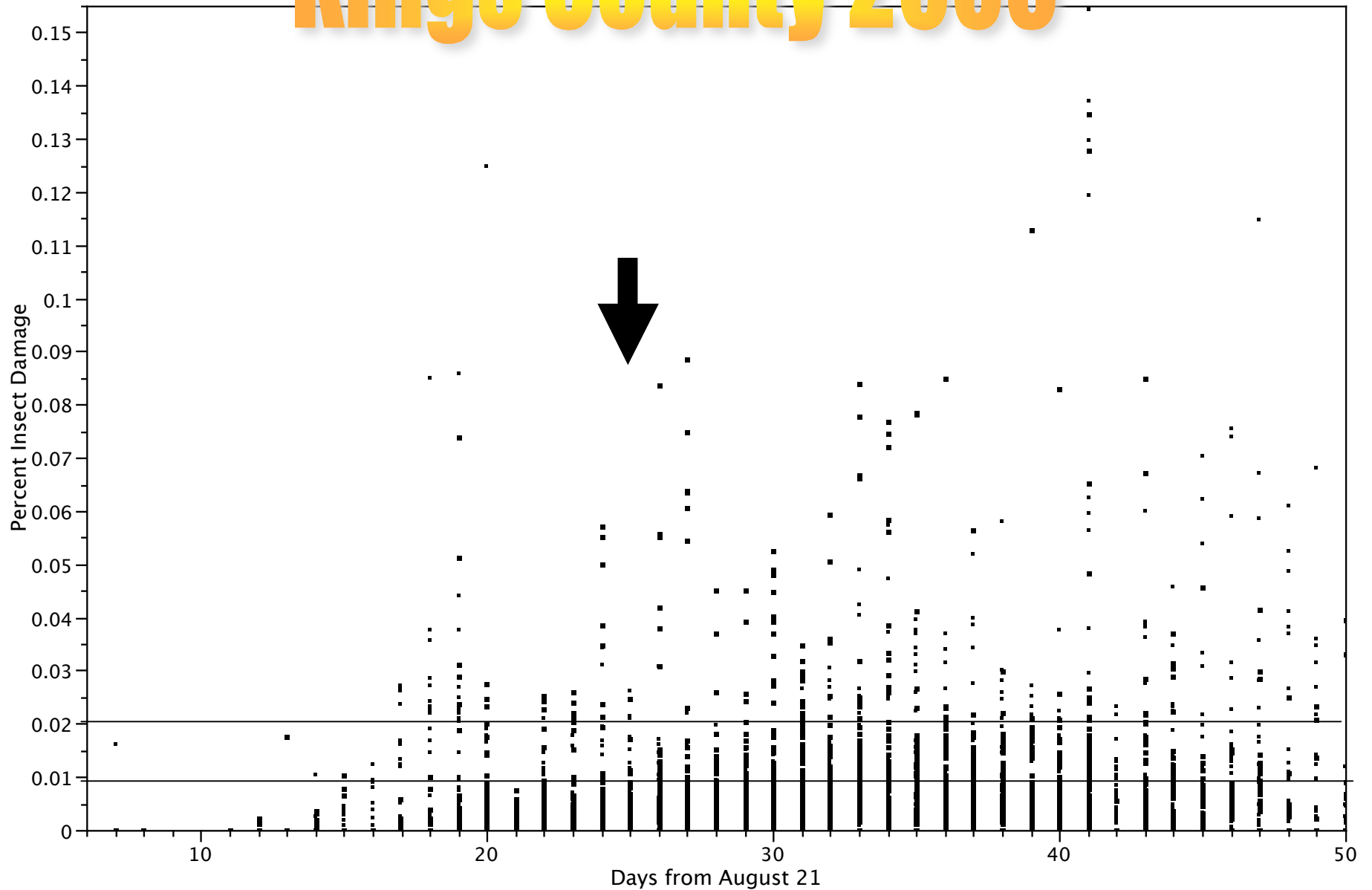
<b>County</b>	<b>Avg. Damage (%)</b>	<b>High (%)</b>	<b>Net Dry Weight</b>	<b>N</b>
<b>Colusa</b>	<b>0.12</b>	<b>1.94</b>	<b>18,469</b>	<b>391</b>
<b>Fresno</b>	<b>0.19</b>	<b>4.87</b>	<b>17,864</b>	<b>1,269</b>
<b>Kern</b>	<b>0.29</b>	<b>6.09</b>	<b>17,721</b>	<b>798</b>
<b>*Kings*</b>	<b>0.90</b>	<b>15.43</b>	<b>17,285</b>	<b>823</b>
<b>Madera</b>	<b>0.59</b>	<b>6.53</b>	<b>19,009</b>	<b>1,274</b>
<b>Tulare</b>	<b>0.53</b>	<b>13.47</b>	<b>16,652</b>	<b>1,610</b>

**Great Year, But...**

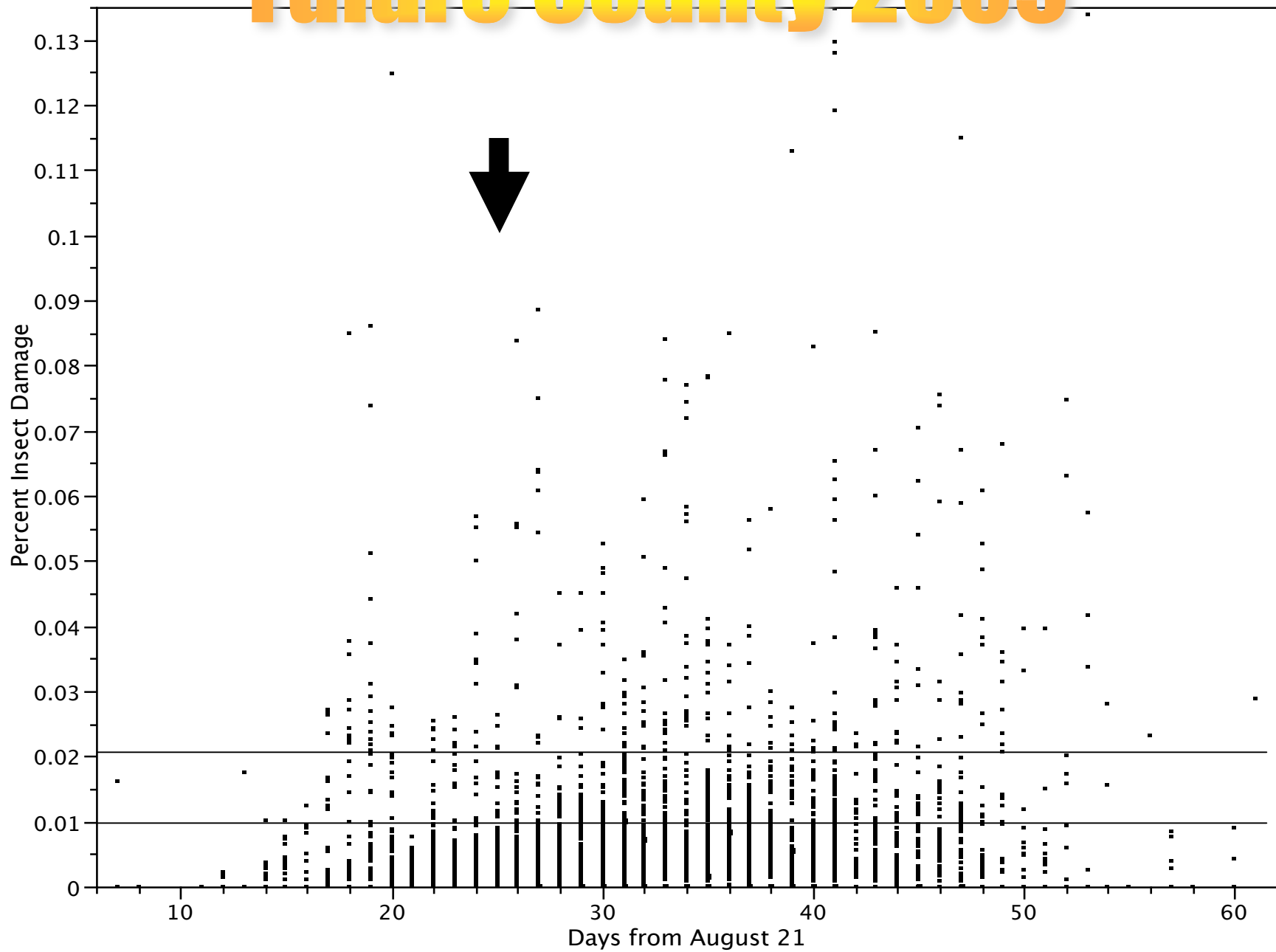
# Madera County 2009



# Kings County 2009



# Tulare County 2009



# Link to Insect Damage

County	Time	% Splits	% Dark Stain	% Shell Defect	% Blanks
<b>Colusa</b>	-	-	-	-	+
<b>Fresno</b>	+	-	+	-	-
<b>Kern</b>	+	+	+	-	+
<b>Kings</b>	-	+	+	+	+
<b>Madera</b>	+	+	+	-	+
<b>Tulare</b>	+	+	+	-	+

# Hull Split, Shell Integrity



# Insecticides, Timing



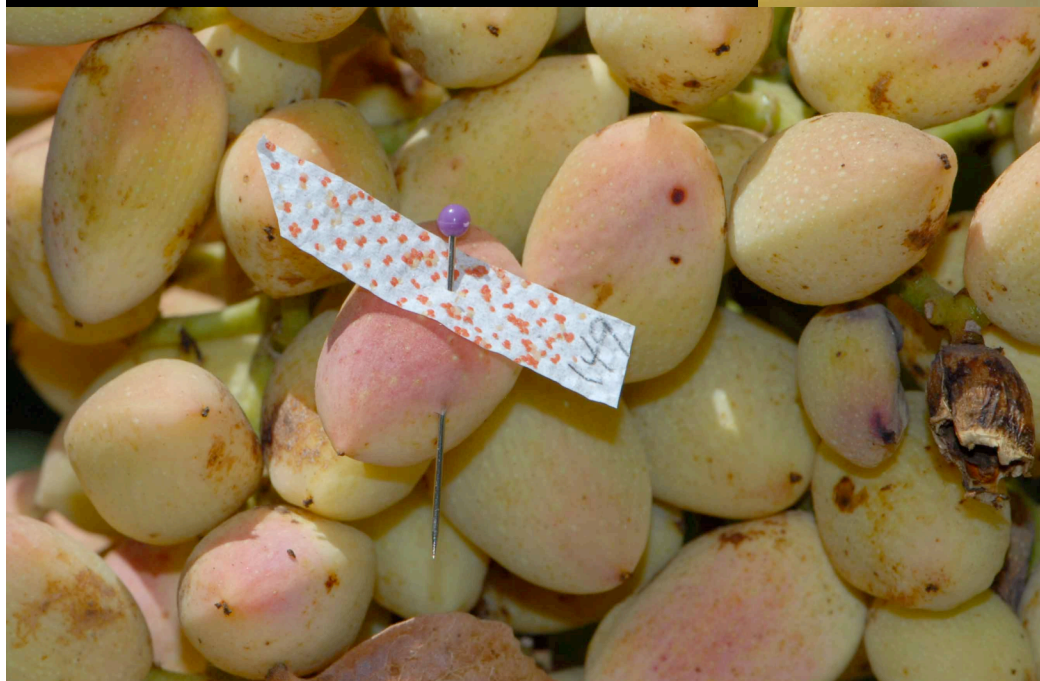


**TIMING**

**CONTROL**

**PERSISTENCE**

# Egg Targets



# Ovicidal/Neonate Activity

<b>Agent</b>	<b>Eggs</b>	<b>Survival</b>	<b>Year</b>
Baythroid XL + Intrepid	3,700	1.35%	2007
Warrior + Intrepid	17,465	0.07%	2008
Brigade	47,287	1.66%	2008
Intrepid	6,881	4.68%	2009
Altacor	5,826	19.02%	2009
Belt	12,256	15.48%	2008
Assail	5,917	30.86%	2009

**BUT**

<b>Insecticide</b>	<b>Eggs</b>	<b>Percent Survival</b>	<b>Reduction compared to Controls</b>
Assail 10 day	200	0.5	98.8%
Assail 14 day	200	1.0	97.6%
Assail 21 day	200	2.0	95.3%
<b>Assail 24 day</b>	<b>600</b>	<b>13.0</b>	<b>69.4%</b>
<b>Assail 34 day</b>	<b>200</b>	<b>16.5</b>	<b>61.1%</b>
Altacor 10 day	200	0	100.0%
Altacor 14 day	200	0	100.0%
Altacor 21 day	200	0	100.0%
Altacor 24 day	200	1.5	96.5%
Altacor 34 day	200	1.0	97.6%
Intrepid 10 day	200	1.0	97.6%
Intrepid 14 day	200	0.5	98.8%
Intrepid 21 day	200	0	100.0%
Intrepid 24 day	400	2.5	94.1%
Intrepid 34 day	200	0	100.0%



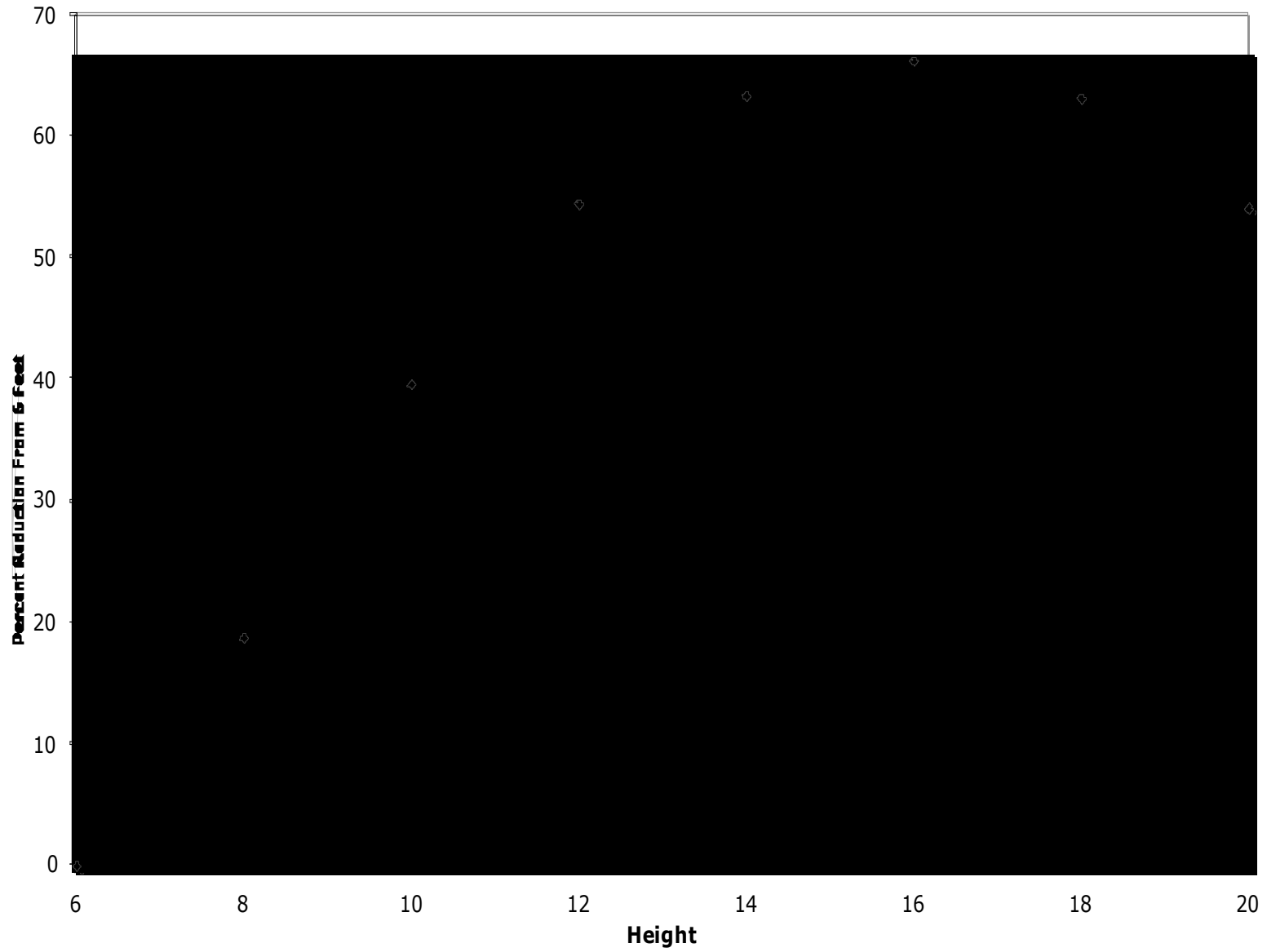
**COVERAGE**

**My thanks  
to work of  
Dr. Jack Dibble  
1955-1991**

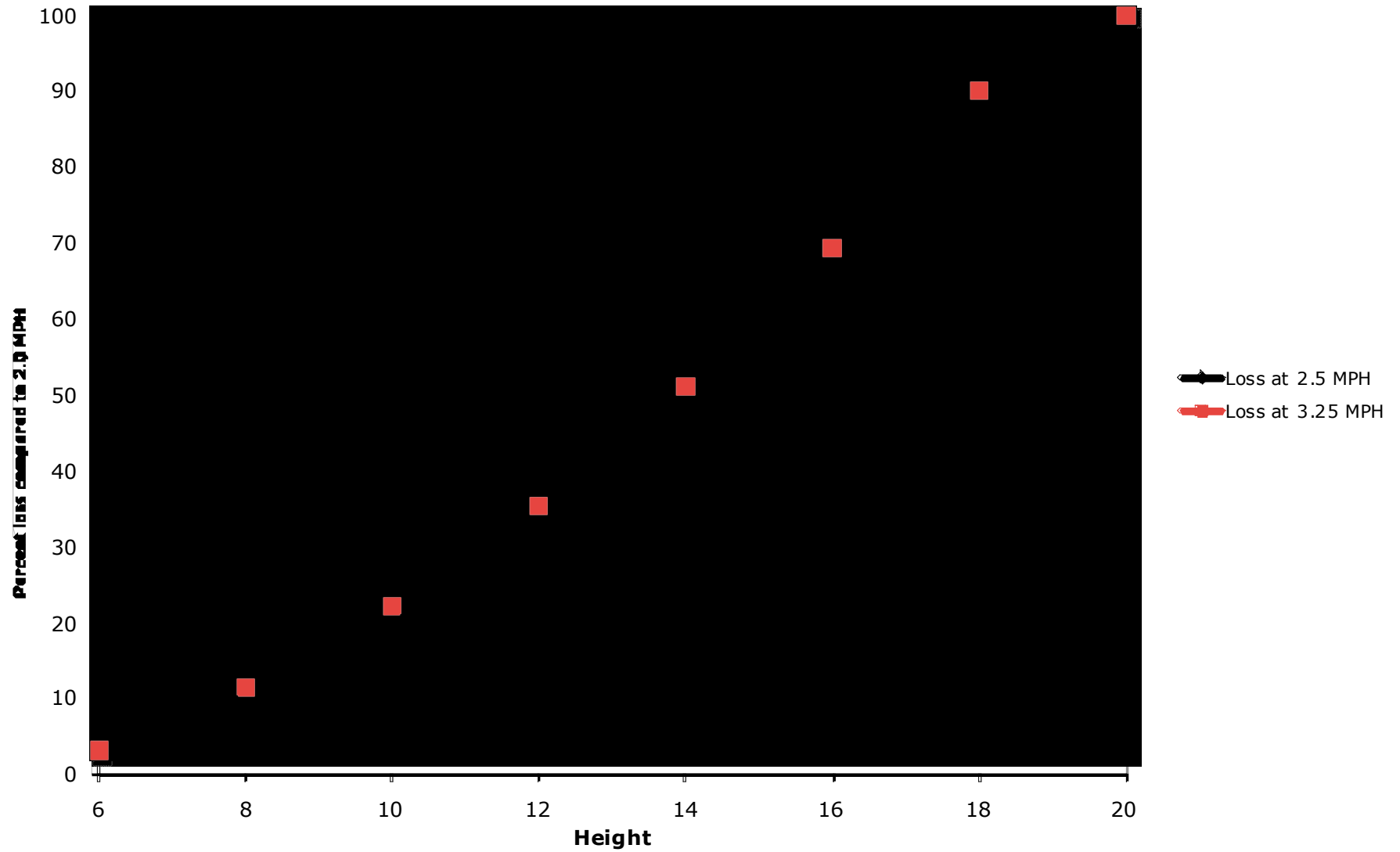
**Vertical Component,  
Horizontal Component  
(Penetration)**



### Predict Loss 2.0 MPH

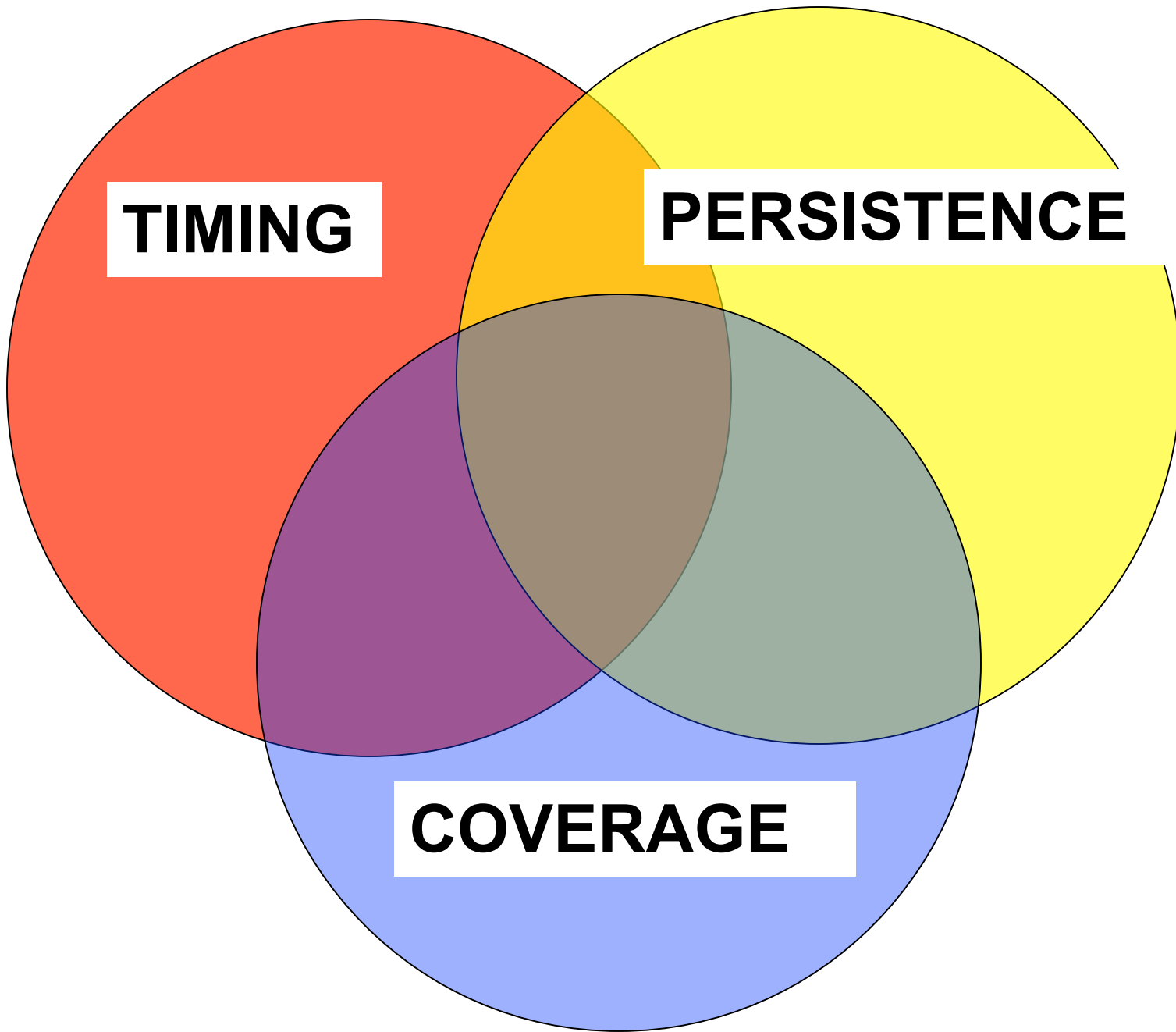


### Spray reduction at 2.5, 3.25 MPH vs 2.0 MPH



**Speeded**

**Kills**



**TIMING**

**PERSISTENCE**

**COVERAGE**

**Thank You**

