



# **INSECT PEST MANAGEMENT ISSUES IN ALFALFA-- CHALLENGES AND QUESTIONS**

**2013 Western Alfalfa &  
Forage Symposium  
December 12, 2013**



# Authors

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# Overview

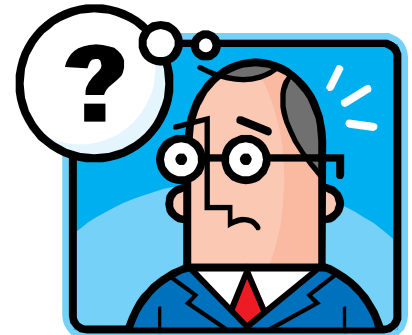
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- Recent challenges in alfalfa IPM
  - Lep. larvae
  - Cowpea aphids
  - Alfalfa weevil
  - Alfalfa stem nematode
- 2013 alfalfa IPM
  - Egyptian alfalfa weevil/alfalfa weevil
  - Blue alfalfa aphid
  - Other aphid species

# Pest Management in Alfalfa

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**2013**



# Origin of Integrated Pest Management (IPM)

- basic ideas setting the groundwork for IPM
- some of these came from observations in the alfalfa system

## H I L G A R D I A

*A Journal of Agricultural Science Published by  
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### **THE INTEGRATED CONTROL CONCEPT<sup>1</sup>**

**VERNON M. STERN, RAY F. SMITH, ROBERT van den BOSCH,  
and KENNETH S. HAGEN<sup>2</sup>**

ALL ORGANISMS are subjected to the physical and biotic pressures of the environments in which they live, and these factors, together with the genetic make-up of the species, determine their abundance and existence in any given area. Without natural control, a species which reproduces more than the parent stock could increase to infinite numbers. Man is subjected to environmental pressures just as other forms of life are, and he competes with other organisms for food and space.

# Origin of Integrated Pest Management (IPM)

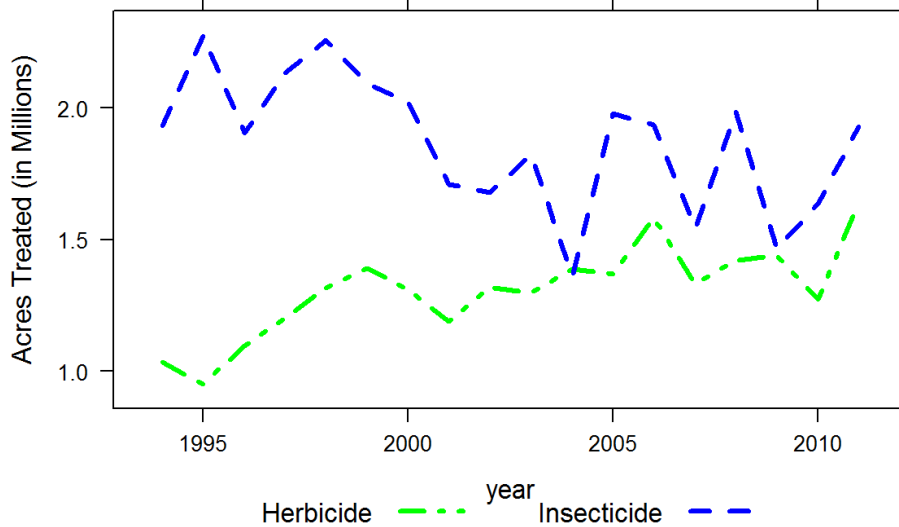
## IPM in the 1950's to 1970's –

- developing as a scientific field
- many of the studies that contributed to the underlying foundation of IPM were conducted in alfalfa
- also extended to growers and implemented leading to a cost-effective and sustainable IPM
- identification of pest and natural enemy species, pest biology (number of generations, overwintering, etc.), sampling techniques and protocols, treatment thresholds, degree-day models, pest distribution over the state

### **Management tactics developed**

- 1.) biological control methods, 3.) host plant resistance
- 2.) cultural control measures 4.) insecticides

# Pesticide Use - Alfalfa



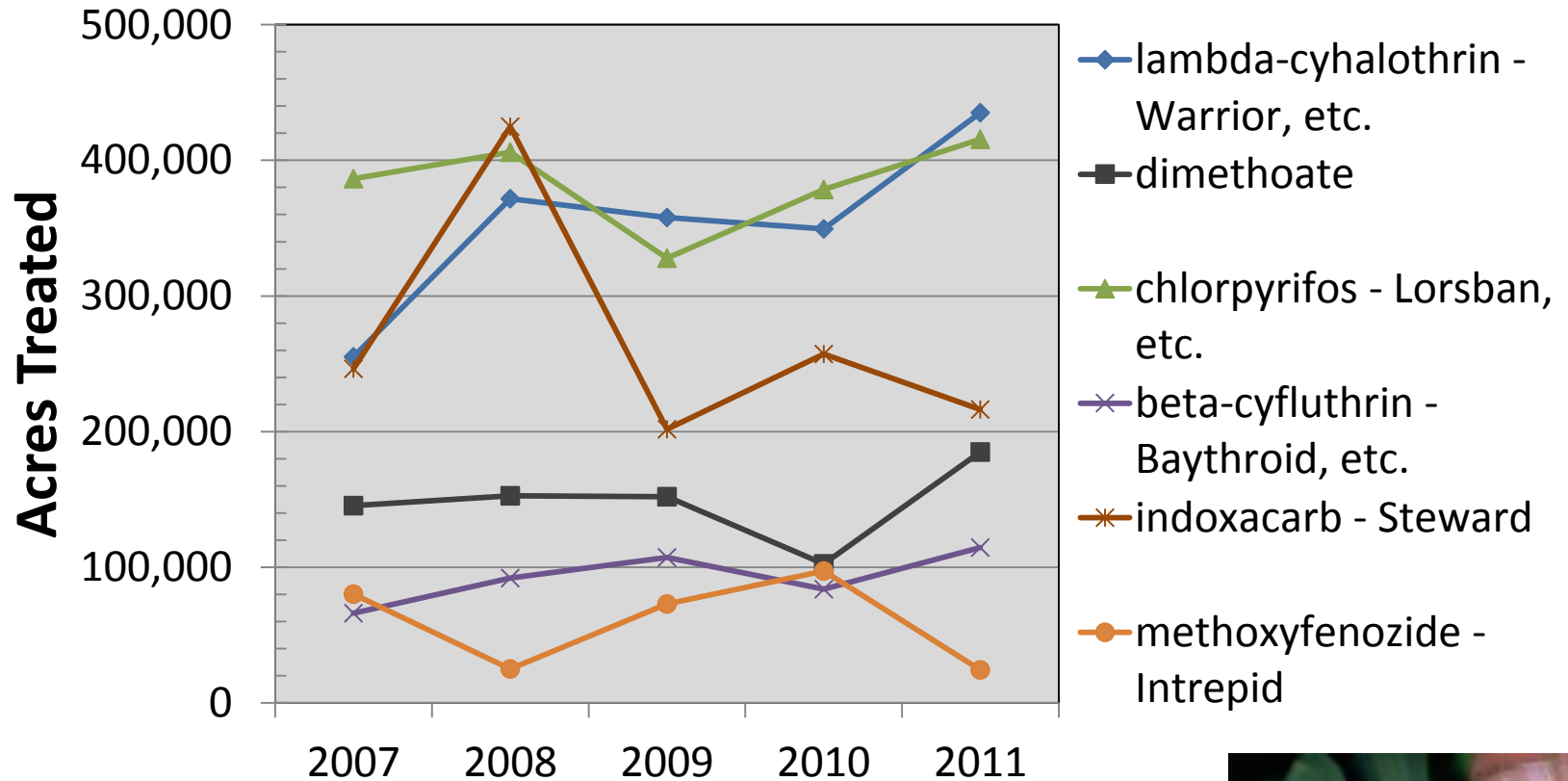
**Cholinesterase-inhibiting pesticides**  
**DPR ground water protection list**  
**DPR toxic air contaminants list**

The top 100 sites used by cumulative acres treated statewide in 2011 (all pesticides combined).

Site	Rank	Pounds	Num. Apps.	Acres
ALMOND	1	25,938,281	338,771	21,228,495
COTTON	2	5,052,680	191,628	17,067,374
GRAPE, WINE	3	29,062,821	384,367	13,164,747
<b>ALFALFA</b>	<b>4</b>	<b>3,524,770</b>	<b>160,420</b>	<b>9,612,344</b>
GRAPE	5	16,734,972	233,084	9,576,148
TOMATO, PROCESSING	6	14,035,941	58,507	4,644,901
RICE	7	4,864,471	61,246	4,266,557
PISTACHIO	8	4,031,449	53,459	3,869,745
WALNUT	9	3,951,571	119,386	3,475,248
ORANGE	10	10,059,959	124,416	3,363,324

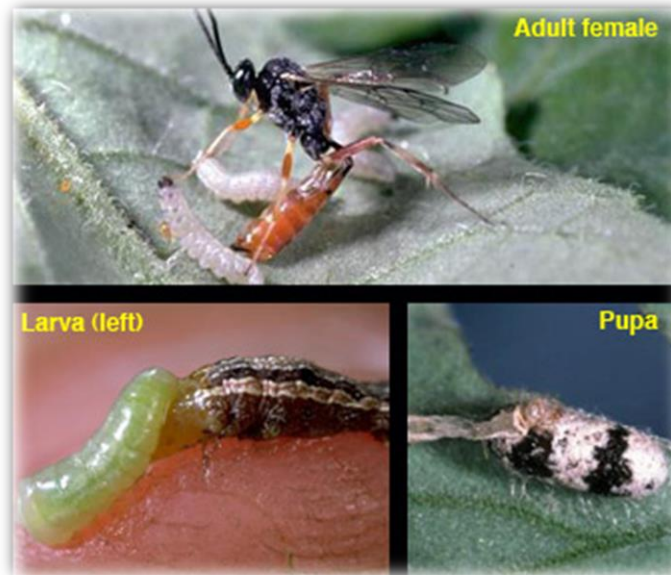


# Pesticide Use - Alfalfa



# Recent challenges in alfalfa IPM

- Lep. larvae/summer worms
  - significant problem during some years
  - appears to be a more common problem
  - used to be more efficiently controlled with natural enemies



# Recent challenges in alfalfa IPM

- Cowpea aphids
  - developed into a pest of alfalfa ~15 years ago
  - marched across the US – reported in Oklahoma, Iowa, Wisconsin, etc. - ~2005-09
  - Used to be a pest only of cowpeas
  - Can be controlled with insecticide treatments
    - applications disrupt natural enemies
  - What caused this?



# Recent challenges in alfalfa IPM

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- Alfalfa stem nematode



# Recent challenges in alfalfa IPM

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- Alfalfa weevil
  - increasing populations in some areas
    - Intermountain areas – used to have sporadic problems with AW
    - Now it is an annual problem and populations reach 75-100 larvae per sweep

# Alfa IPM

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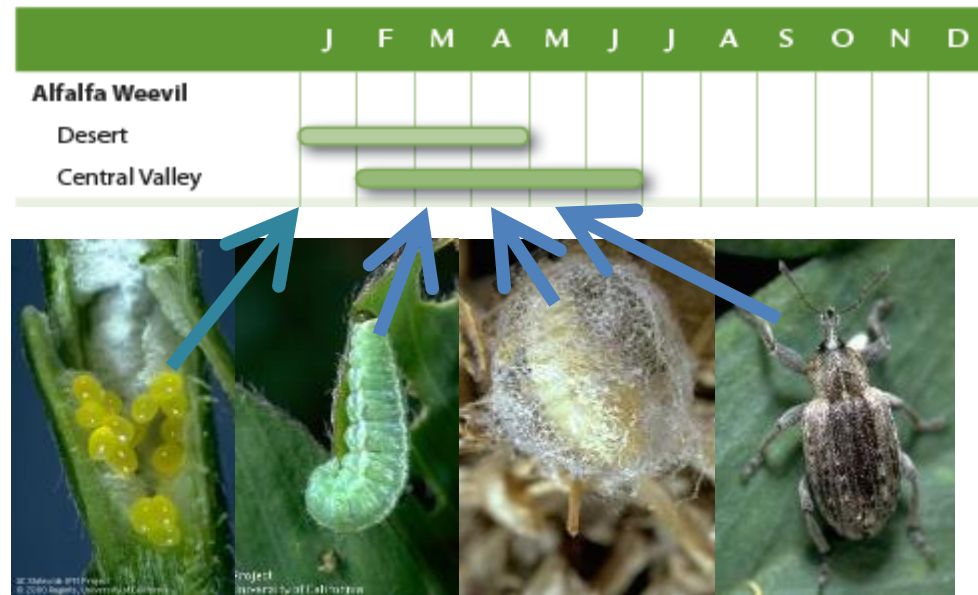


# 2013 alfalfa IPM

## ■ Alfalfa weevil

### ■ increasing length of infestation

- Small area in Tulare Co. with 2<sup>nd</sup> generation (Summers)
- 2013 – 2<sup>nd</sup> generation reported from Merced, San Joaquin, Fresno Co.
- some treatments required on 2<sup>nd</sup> generation
- Davis campus – weevil larvae in mid-August



# 2013 alfalfa IPM

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- Alfalfa weevil
  - difficulties in managing weevil larvae for 1<sup>st</sup> generation
    - Tank mixes - Cobalt<sup>®</sup>, Stallion<sup>®</sup>, etc.
    - Second application



# Recent challenges in alfalfa IPM

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- 2013 alfalfa IPM
  - Egyptian alfalfa weevil/alfalfa weevil
  - **Blue alfalfa aphid**
  - **Other aphid species**

# Blue Alfalfa Aphid Outbreak 2013

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# Observations on:

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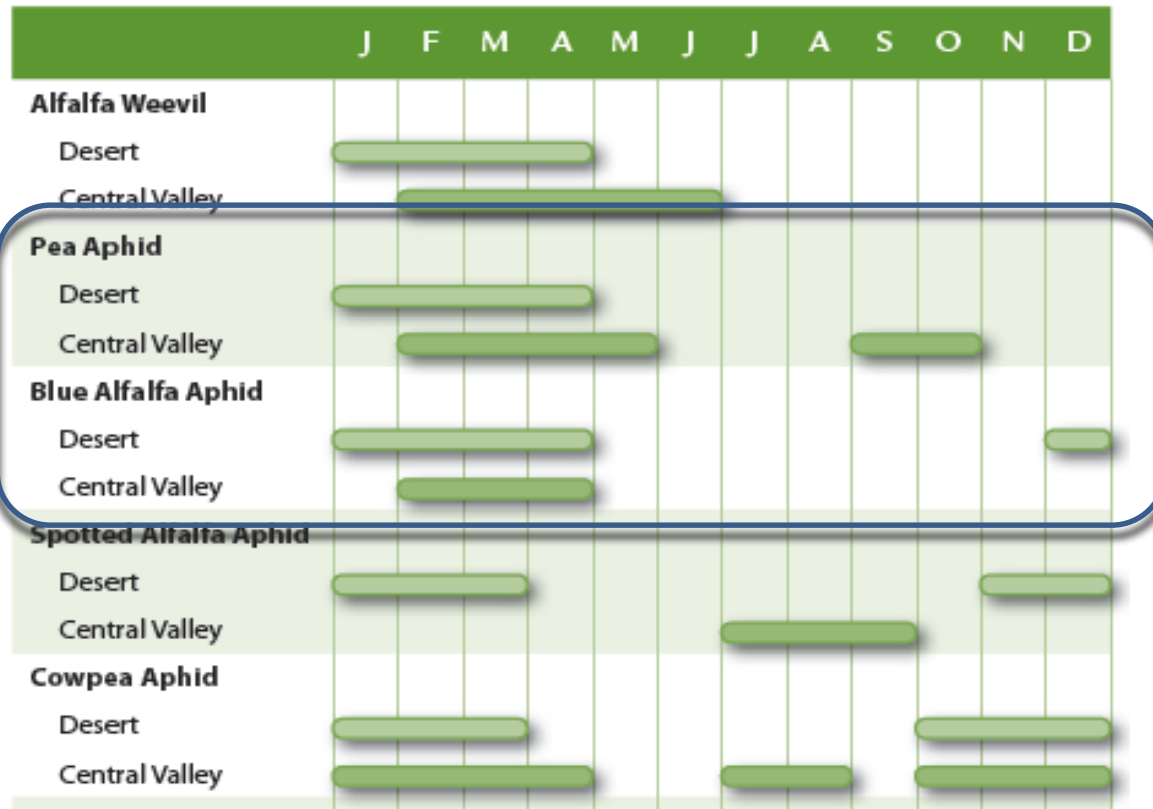


Spotted Alfalfa Aphid  
populations 2013

Pea Aphid populations  
2013



# Aphid Biology



# Common Aphids in Alfalfa



- **Blue Alfalfa Aphid**

- Antenna uniformly brown

- **Pea Aphid**

- Narrow dark bands at tip of each segment



# Common Aphids in Alfalfa

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- **Cowpea Aphid**
  - Adult: shiny black
  - Nymph: slate grey

- **Spotted Alfalfa Aphid**

A small, pale-yellow or grayish aphid with four to six rows of spined black spots on its back



# Which of These Aphids is Blue Alfalfa Aphid?



**Blue Alfalfa**



# How Would You Know?

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- Alfalfa Blog, UC Davis -  
<http://ucanr.edu/blogs/Alfalfa/index.cfm>
- IPM Identification Tips in Alfalfa PMG
  - <http://www.ipm.ucdavis.edu/PMG/r1300211.html>
- Additional Guides:
  - Barlow & Godfrey Aphid Guide
  - [http://ucanr.edu/sites/CottonIPM/Useful Resources/](http://ucanr.edu/sites/CottonIPM/Useful_Resources/)

**Pea Aphid –  
*Acyrtosiphon pisum***

**Blue Alfalfa –  
*Acyrtosiphon kondoi***

Spring and fall populations

Late winter or spring only

More widely distributed on plant

Prefers terminal area of plant

Feeding does NOT result in stunting

Injects feeding toxin, stunts plants,  
especially young

Action Thresholds (under 10") – 40-  
50 aphids per sweep

Action Thresholds (under 10") – 10-  
12 aphids per sweep

Less tolerant of cool temperatures

More tolerant of cool temperatures

Some resistance in commercial  
alfalfa varieties

Resistance common in commercial  
alfalfa varieties

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# History - Aphids in Alfalfa

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- **Pea Aphid** - in the western U.S. for 100+ years
- **Spotted Alfalfa Aphid** – first found in 1950's
- **Blue Alfalfa Aphid** - first found in CA in Kern Co. near Bakersfield in 1974 and Imperial Co. in 1975
- **Cowpea Aphid** – started damaging alfalfa ~15 years ago

# Management - Aphids in Alfalfa

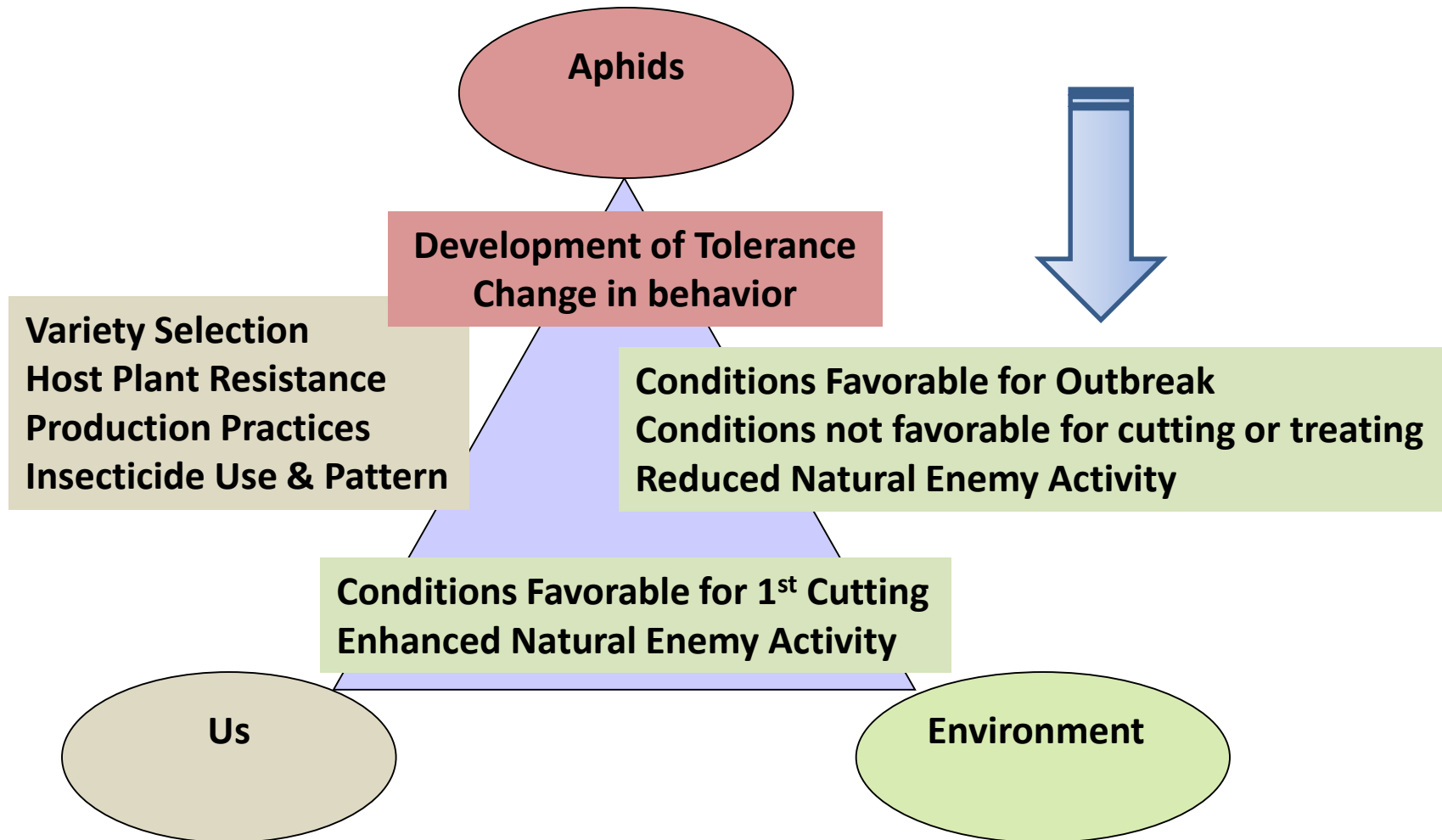
	<b>Insecticides</b>	<b>Cultural</b>	<b>Biological</b>	<b>Host Plant Resistance</b>
Pea Aphid	X		XX	X
Blue Alfalfa Aphid	X		XX	XX
Spotted Alfalfa Aphid	X		X	XX
Cowpea Aphid	XX		X	

# Blue Alfalfa Aphid Outbreak 2013



# Outbreaks Are Complex Events

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# Outbreaks Are Complex Events

Conditions Favorable for Outbreak  
Conditions Not Favorable for Cutting or Treating  
Reduced Natural Enemy Activity

- Some years have the perfect environmental conditions for the build-up of certain pest species
- 2013- levels of several aphid and leafhopper species were very high, also whiteflies
- May be due to increased reproduction by pest species
- Or due to reduced activity of natural enemies



# Outbreaks Are Complex Events

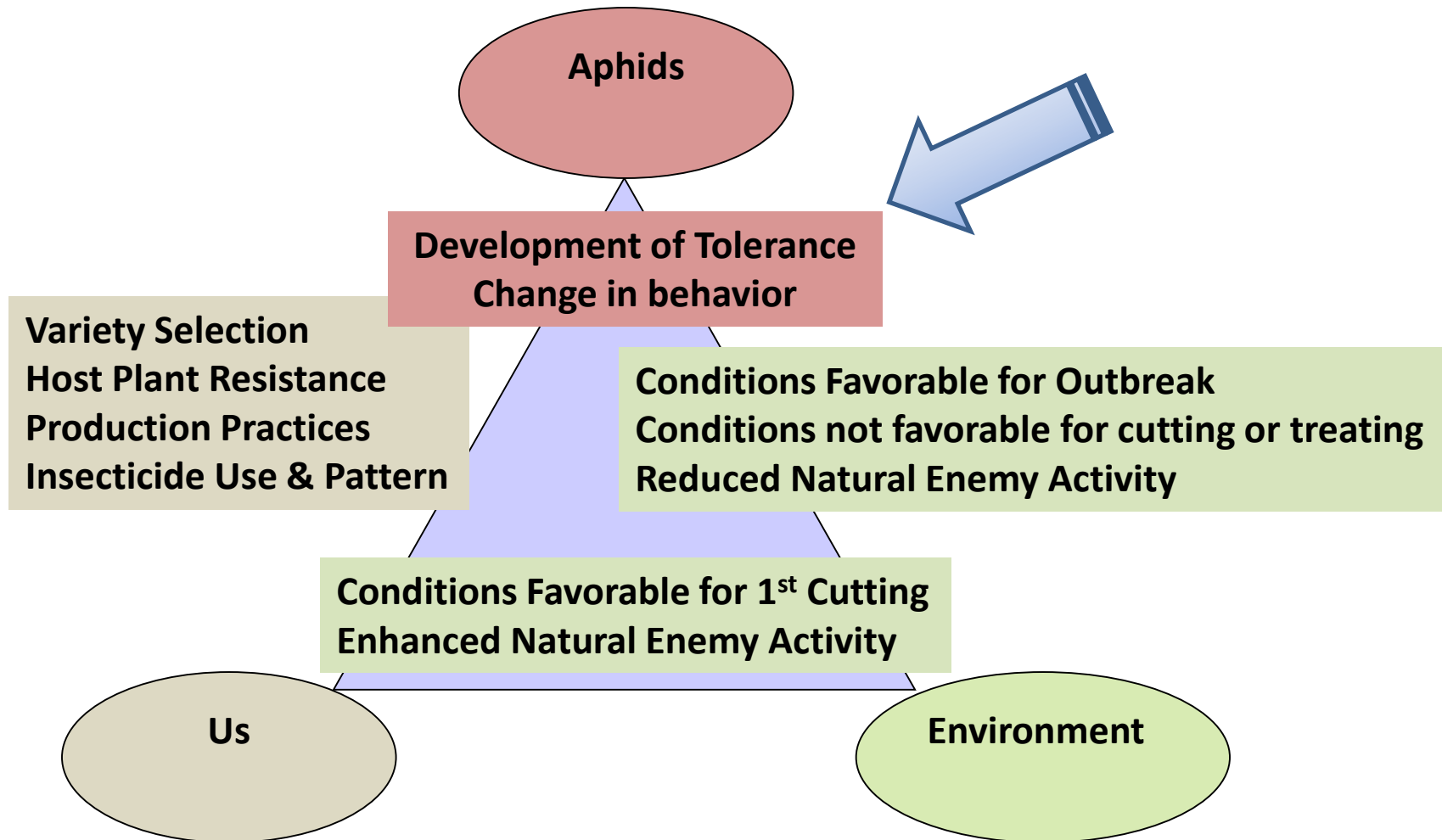
Conditions Favorable for Outbreak  
Conditions Not Favorable for Cutting or Treating  
Reduced Natural Enemy Activity

	# per 50 sweeps	
	2012	2013
BEB adults	6.25	0.4
BEB nymphs	1.0	0.1



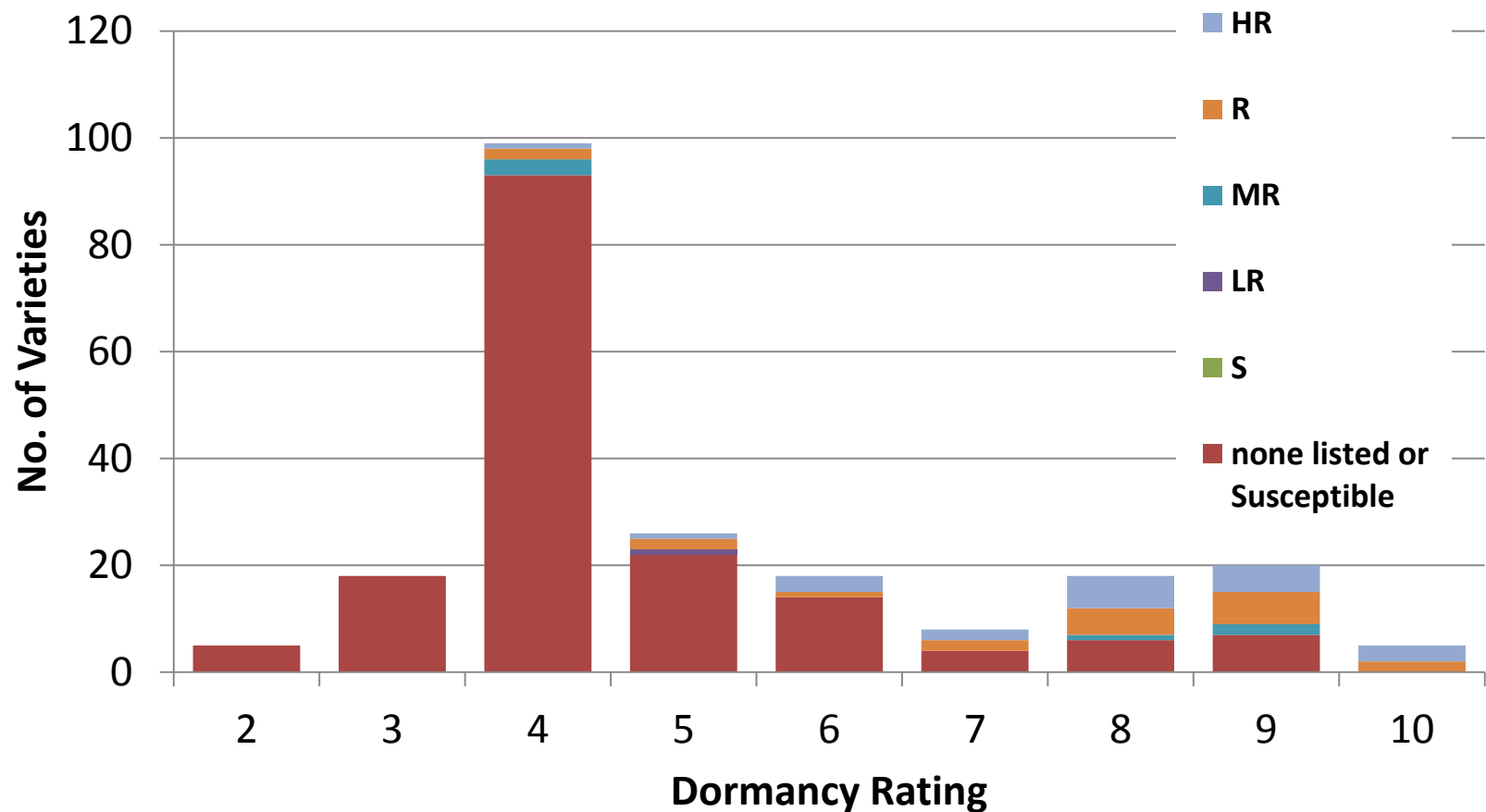
# Outbreaks Are Complex Events

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# Host Plant Resistance to Blue Alfalfa Aphid



Source: NAFA 2013

# Outbreaks Are Complex Events

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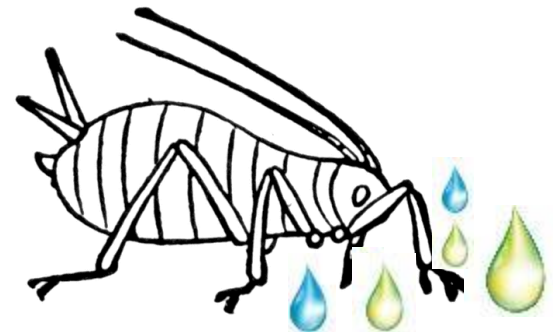
## Development of Tolerance Change in Behavior

- Alfalfa varieties have been selected to have a level of host plant resistance to SAA and BAA
- This approach had been used for SAA in the 1950's
- CUF 101 was developed with BAA resistance
- Mainstay of management since BAA and SAA introductions
- Host Plant Resistance - antibiosis is involved
  - compound bred into alfalfa that aphids cannot tolerate

# Outbreaks Are Complex Events

Development of Tolerance  
Change in Behavior

- Aphids attempt to “evolve” to overcome resistance
- When this happens they reproduce successfully – build-up numbers
- Host plant resistance is virtually lost at 60F
- Host plant resistance is very active at 70F and above
- HPR poorly expressed under cool temperatures and BAA reproduces best under cool conditions



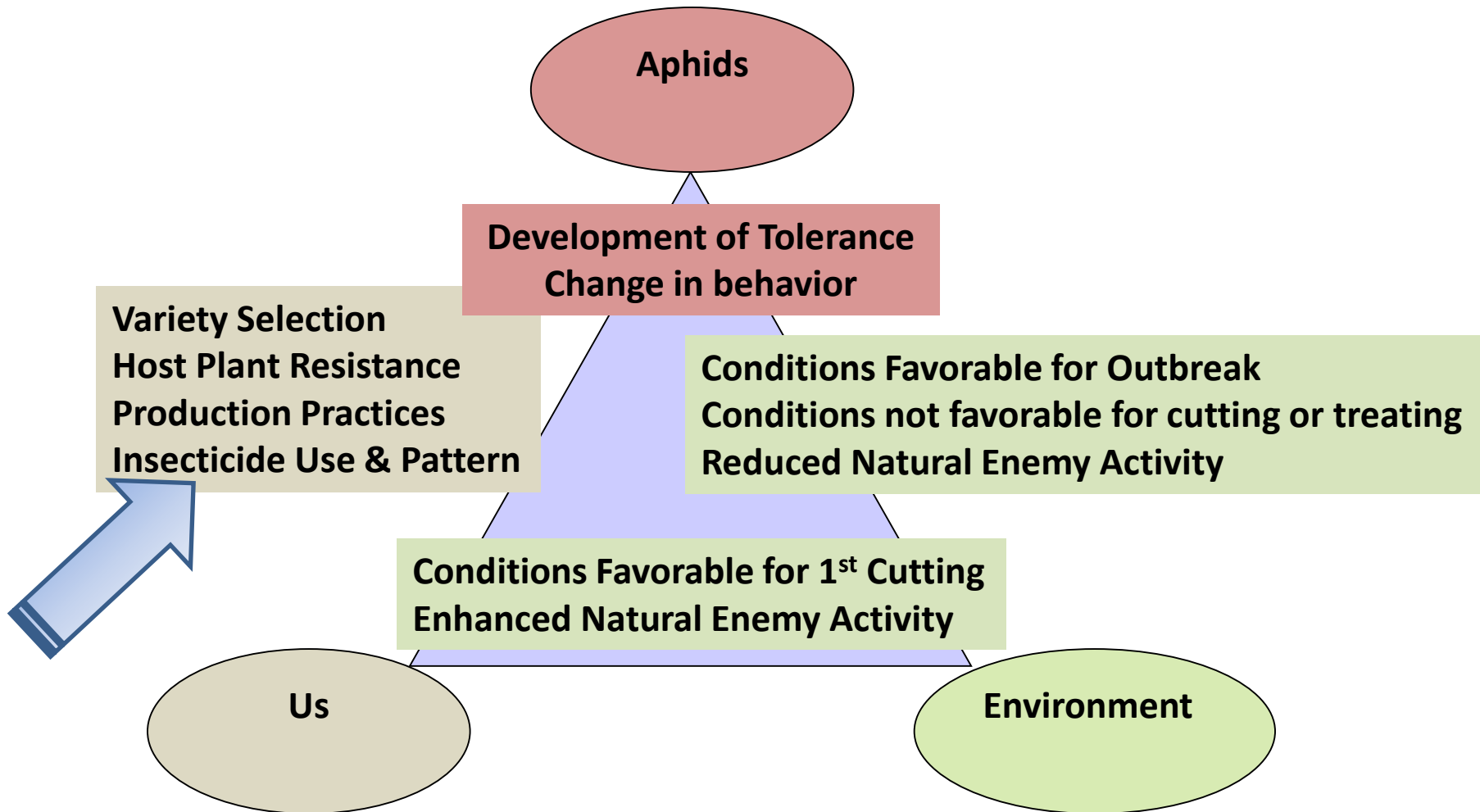
# Outbreaks Are Complex Events - Cause of Outbreak?

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- Failure of Host Plant Resistance
  - Not likely to ramp up in one year
- New Type of Aphid / New Biotype
  - “Nebraska” strain
  - pursued lead but found no evidence
- RR alfalfa
  - No evidence

# Outbreaks Are Complex Events

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# Outbreaks Are Complex Events - Cause of Outbreak?

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- Insecticide Resistance - ??
- Aphids attempt to “evolve” to overcome insecticide toxicity
- When this happens they reproduce successfully – build-up numbers
- How?
  - “Poor control”
  - Poor knockdown
  - Poor residual control
  - Higher populations

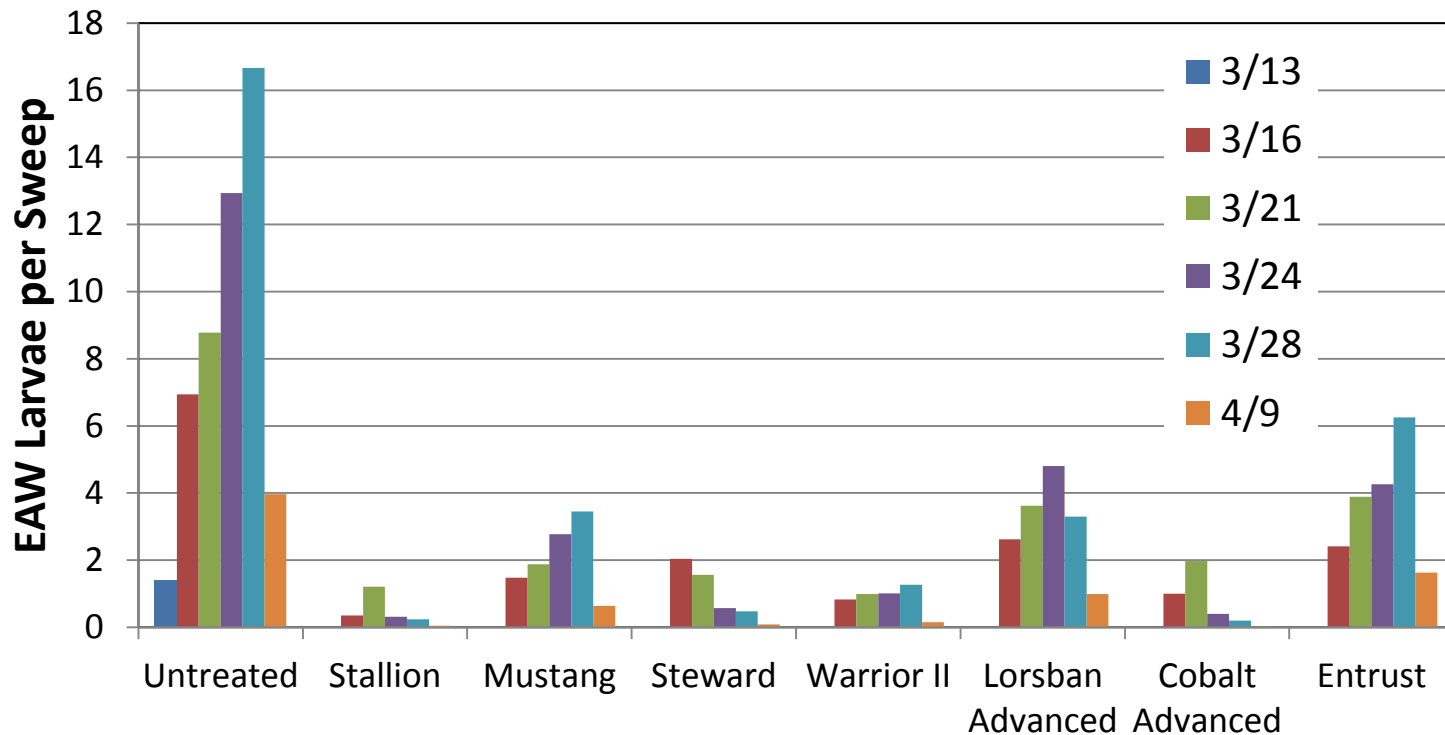
# Outbreaks Are Complex Events - Cause of Outbreak?

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- Insecticide Resistance - ??
- Dow AgroSciences conducted quick “dip assay”
  - No evidence of increased tolerance to chlorpyrifos

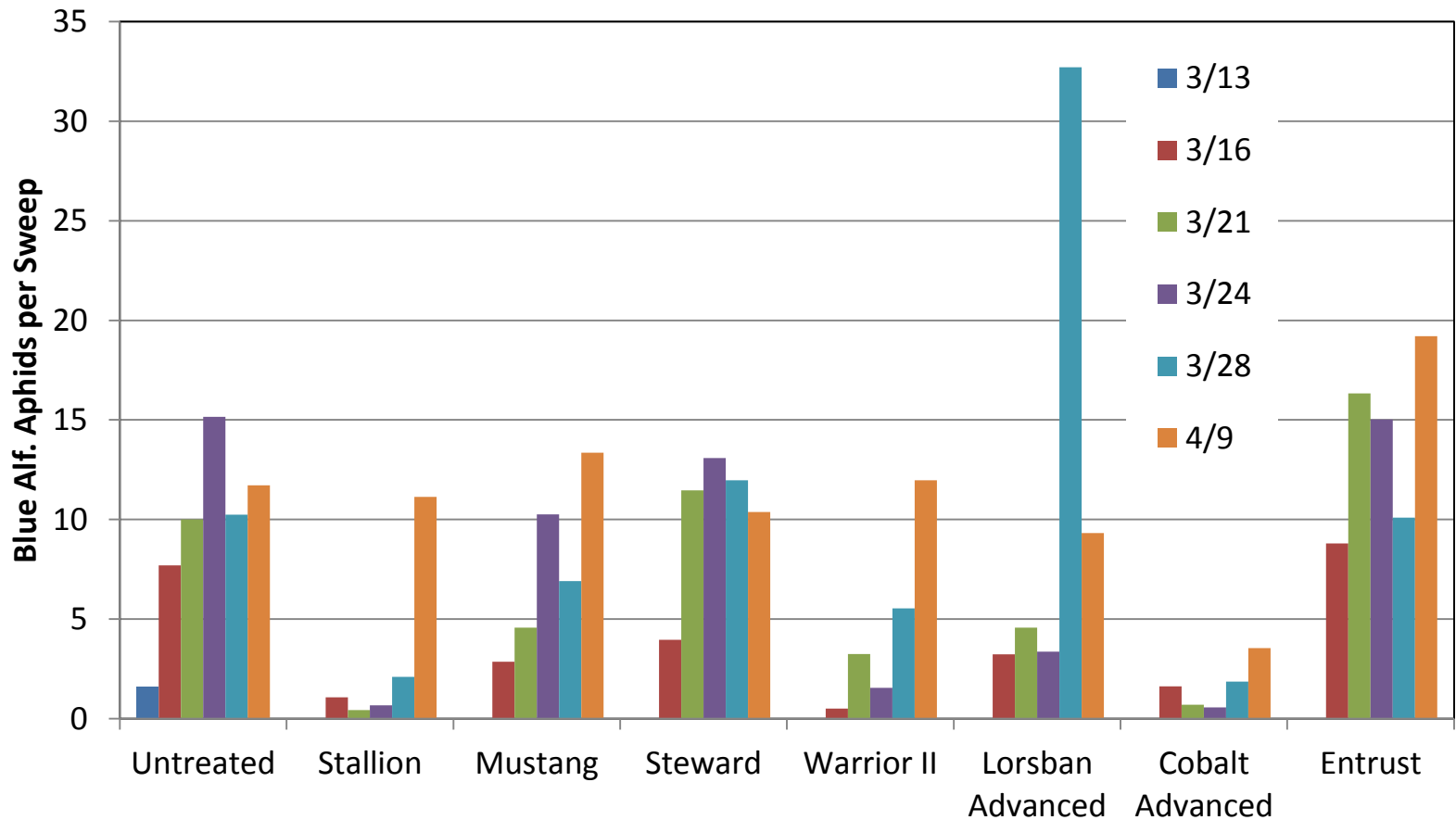
# EAW & Aphid Trial, Davis

## March 2013



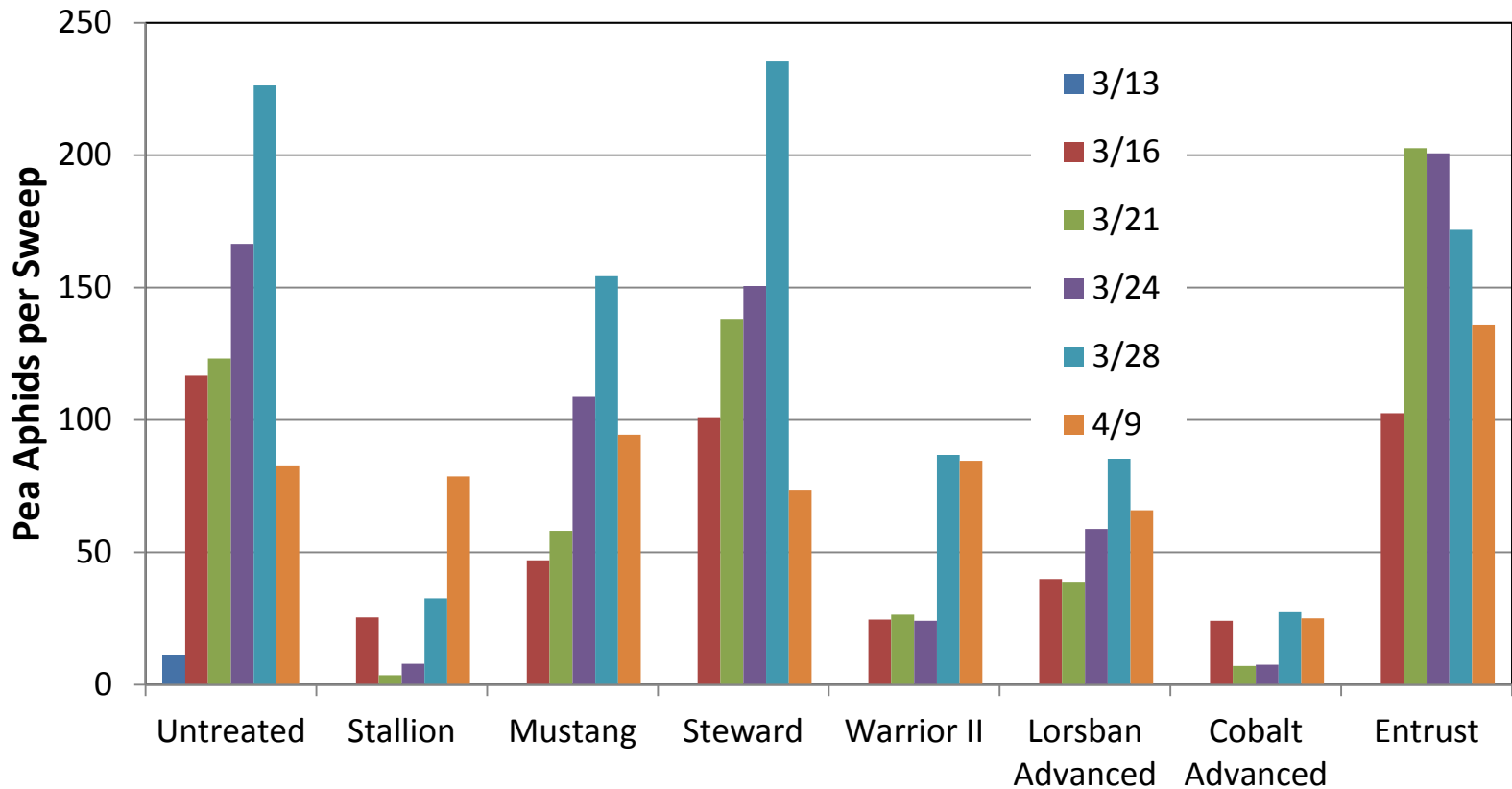
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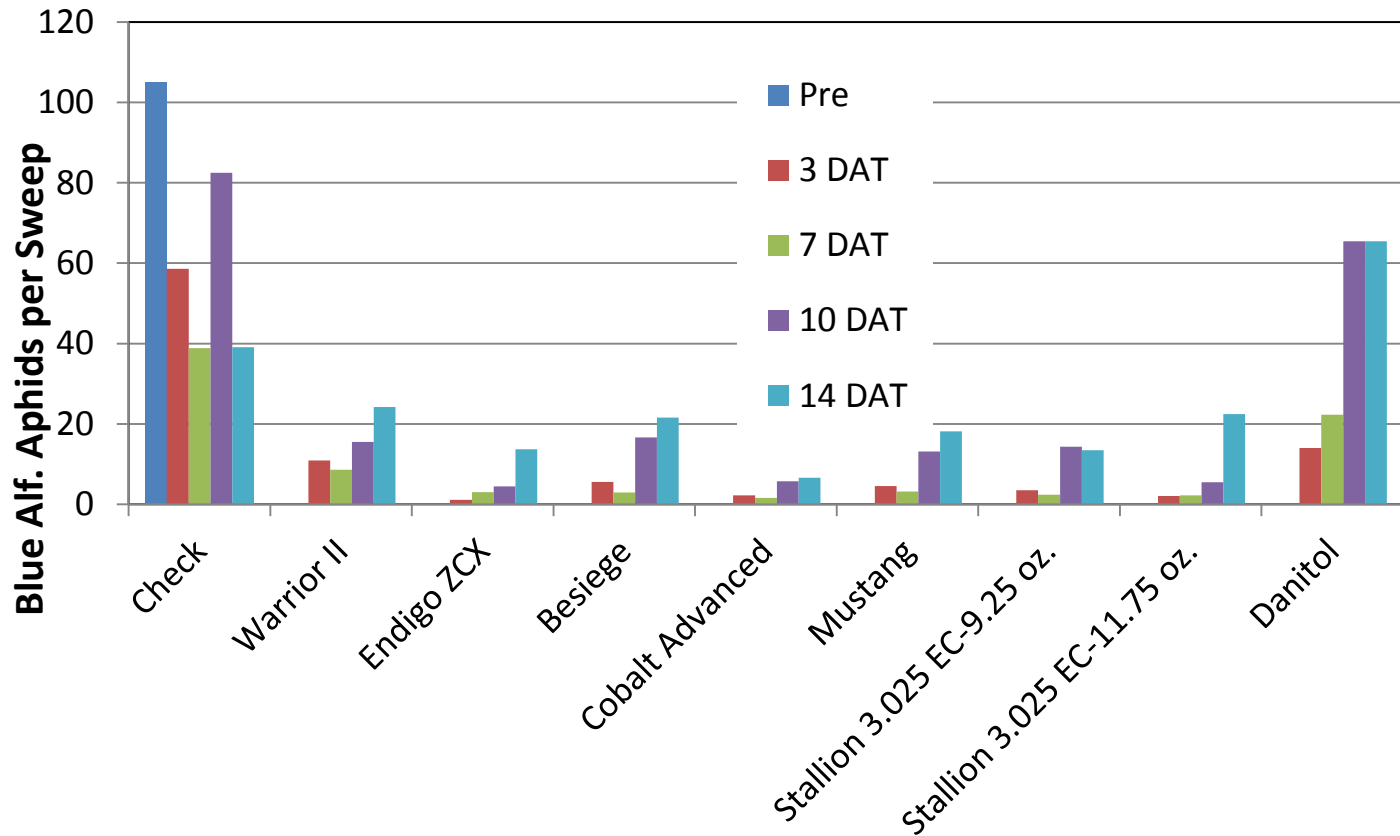


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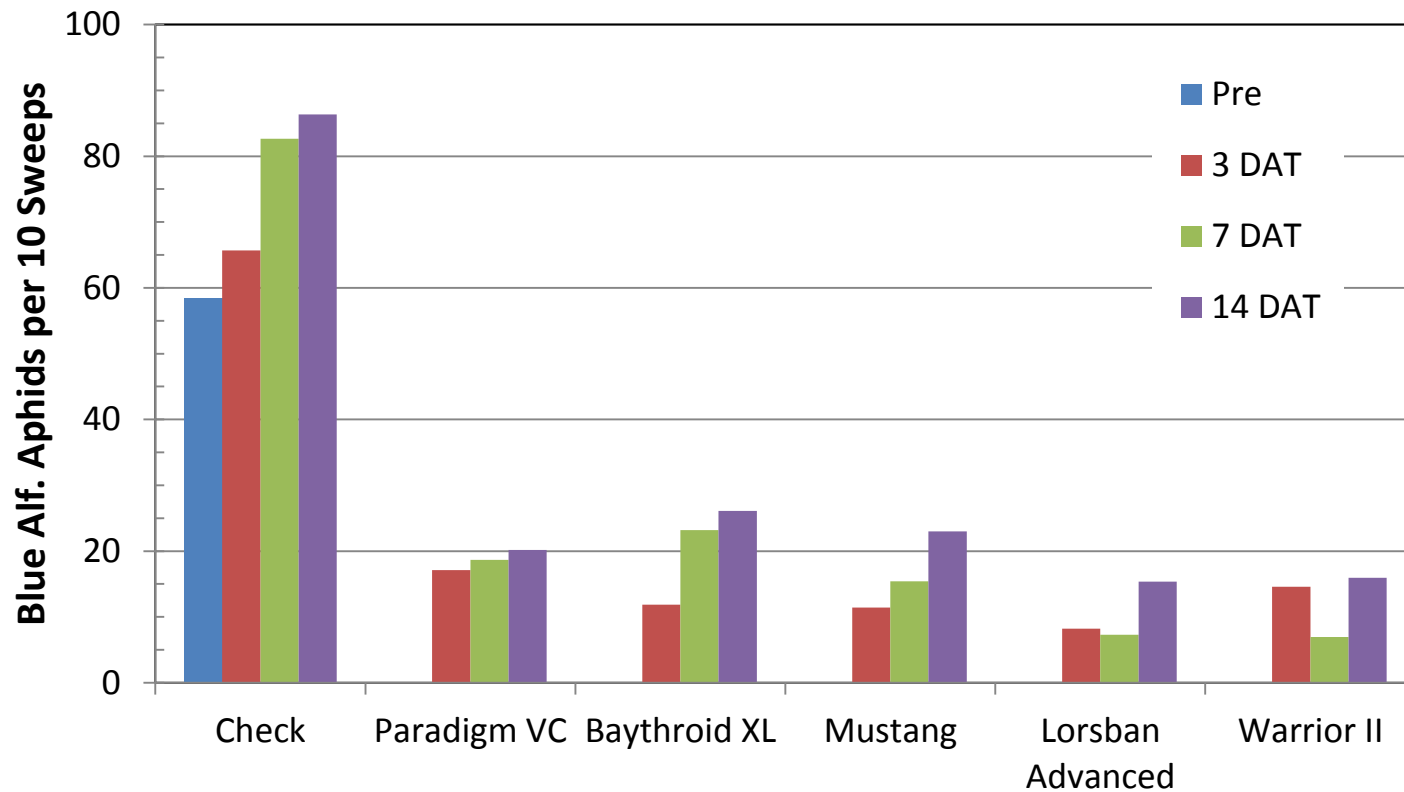
## March 2013



# Aphid Trial, Imp. Valley 2013

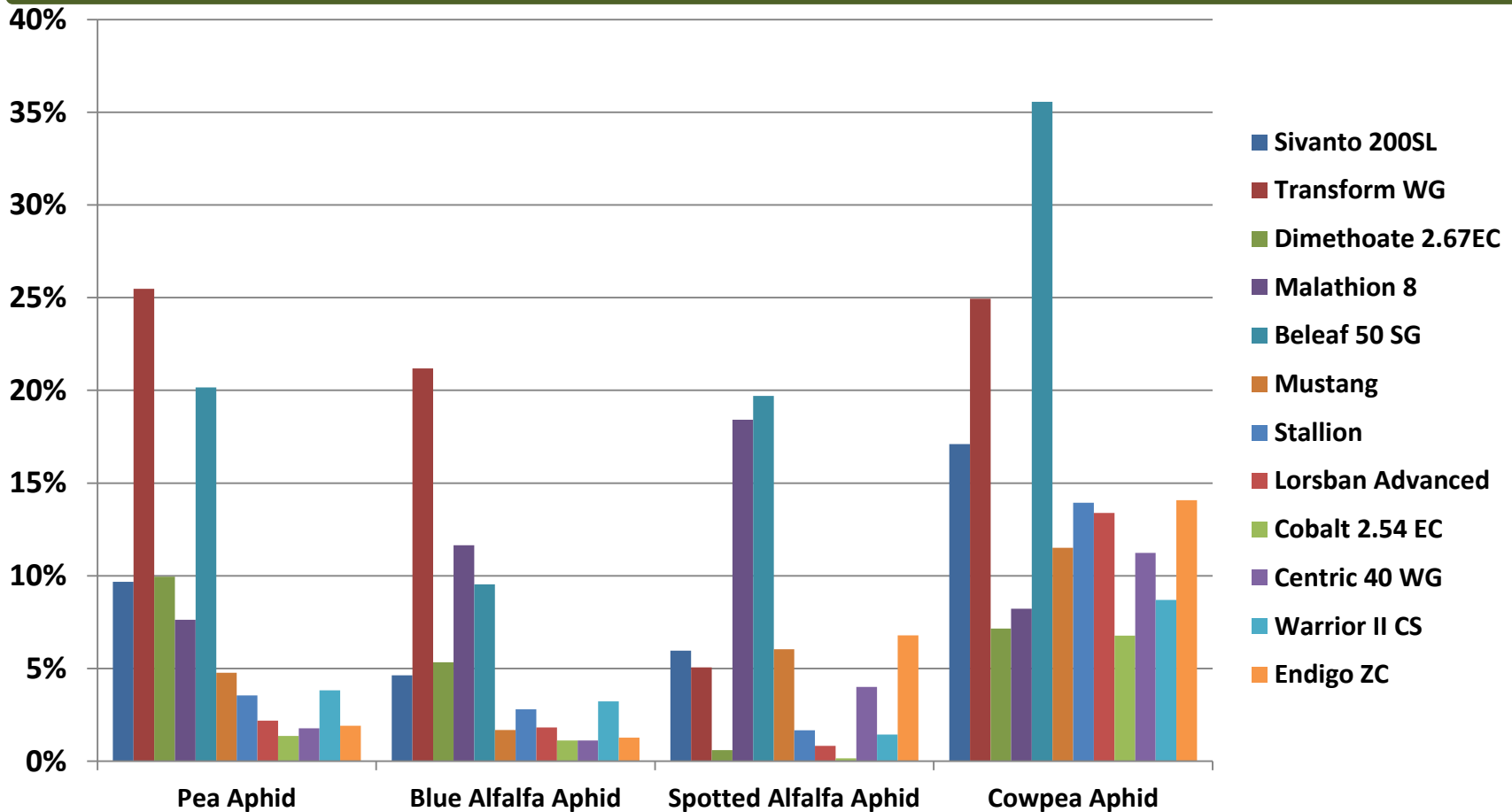


# Aphid Trial, Imp. Valley 2013



# Aphid Trial, Imperial Valley

## 17 January 2013



Percent of Check, Post Treatment Average

# Characteristics of 2013 Outbreak

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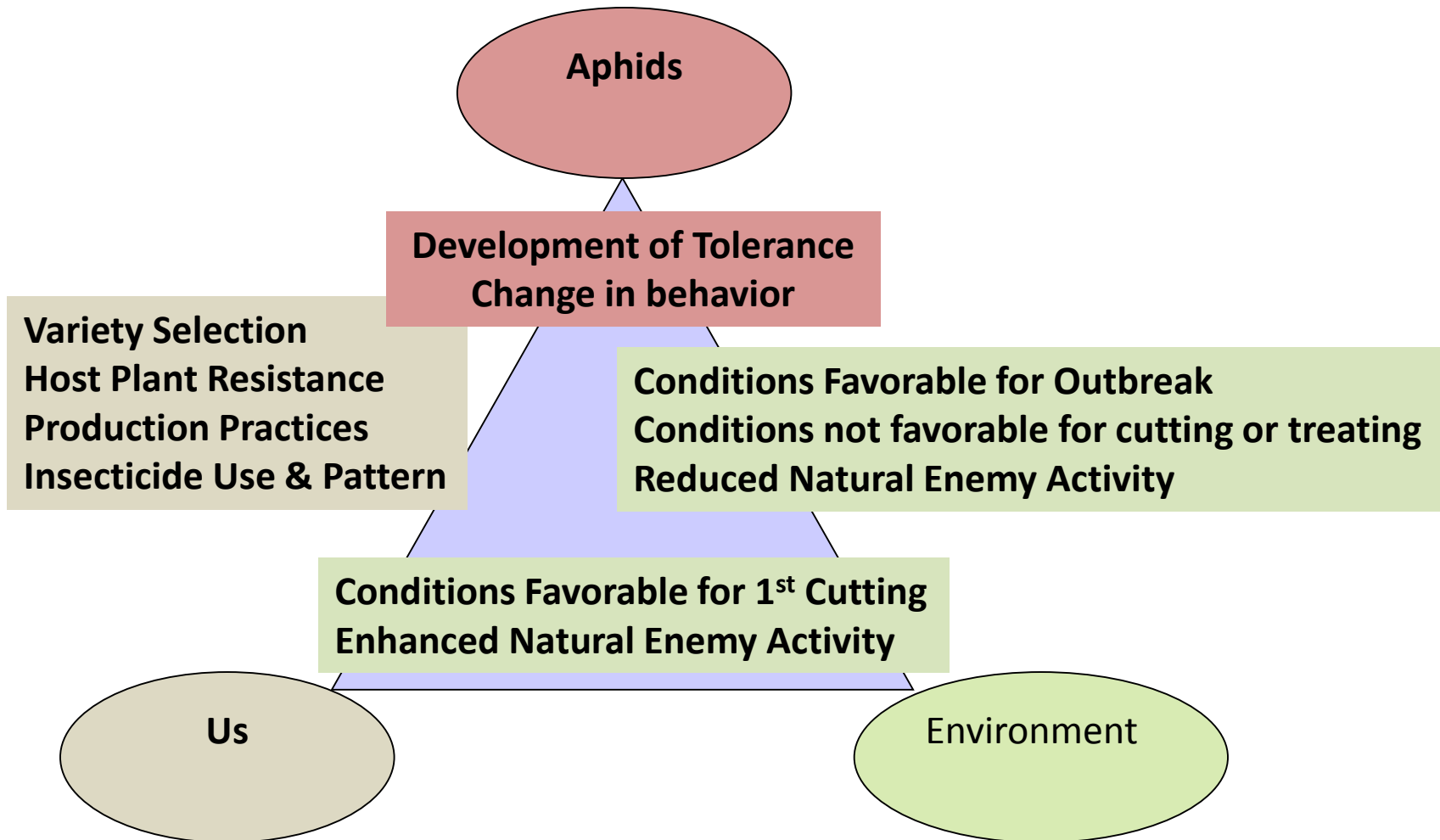
- Good weevil control, usual aphid materials
- Resurgence of BAA, 1-2 weeks post weevil
- Retreatment required
- Control difficult, residual control lacking
- “Numbers game”
- **Spotty, not widespread**
- Timing of outbreak varies by location
- Some noted low abundance of natural enemies
- Damage substantial in some cases
- Lingering effect of toxin not known

# Outbreaks Reported 2013



# Outbreaks Are Complex Events

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# Damage: stunting, reduced vigor

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Dos Palos,  
Merced Co

9 inches tall  
30 days post 1<sup>st</sup> cutting

High Desert,  
Lancaster, CA



# What Losses Did People Report Due to BAA?

Region	Acres Infested	Loss	Stand Age	Damage Severity Ranking 1 low, 5 high
Imperial Valley	> 1000 acres	\$70/ac, 1/3 ton	3 <sup>rd</sup> Year	4
Dos Palos	500-1000 acres			
Dos Palos	>1000 acres	\$250/ac for 2 cuttings	3 <sup>rd</sup> Year	5
Dos Palos		\$150/acre	2 <sup>nd</sup> Year	5
Buttonwillow	>1000 acres	½ - ¾ bale	2 <sup>nd</sup> & 3 <sup>rd</sup> Yr.	3
Dos Palos	85 acres	\$90/ac	second	5
Dos Palos	100-500	40% reduction	3-5 <sup>th</sup>	4
Palo Verde Valley	> 1000	\$100/acre	2 months to 3 <sup>rd</sup> Year	5
Palo Verde Valley	> 1000	\$125/acre	4 <sup>th</sup> Year	5

# Outbreaks Are Complex Events - Cause of Outbreak?

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- Insecticide Resistance
- Failure of Host Plant Resistance
- Change in biological control
- Unusual weather/winter
- New Biotype

# It's a Numbers Game

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- 95% efficacy may leave too many aphids, especially if being concentrated in windrows (e.g. “early cutting”)
- Use of broad spectrum insecticides reduce your biocontrol assets in the field
- Population more likely to rebound
- OPs did not sufficiently control BAA

# It's a Numbers Game

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- What if.....
  - You found only 60 aphids just before 1<sup>st</sup> cutting?
  - Did not recognize them as BAA, thinking they were Pea Aphids
  - Cut (possibly earlier), thereby concentrating BAA into windrows, even if 50% mortality
  - That leaves 30/stem on stubble and already at 75% of Action Threshold
  - And creates a pattern in the field of stunted regrowth where the windrow lay



