What's New in Almond Pest Management

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What's New in Almond Pest Management

Moderator: Bob Curtis, ABC

Presenters:

Jim Adaskaveg, Plant Pathology, UC Riverside

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Disease Management Update

J.E. Adaskaveg
University of California, Riverside

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Currently Registered and New Fungicides for Almond Production in California

Development of New Fungicides for Managing Almond Diseases

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Single-fungicides - Inorganics and Conventional Synthetics

Inorganics
Copper, Sulfur
M1
1960s

Dithiocarbamates
Ziram, (Maneb)
M2
1940s

Phthalimides
Captan
M3
1950s

Isophthalonitriles
Bravo, Echo, Equus
M4
1960s

Guanidines
Syllit
M6
1960s

Benzimidazoles
Topsin-M, T-Methyl
1
1970s

Hydroxyanilides
Elevate
17
1990s

Sterol inhibitors (DMIs)
Rally, Laredo, Orbit, Indar, Quash, Inspire
3
1970s - 1980s

SDHIs
Luna Privilege, Xemium, Fontelis
7
1960s

Anilinopyrimidines
Vangard, Scala
9
1990s

Dicarboximides
Rovral, Iprodione, Nevado
2
1980s

New in 2011: **Fontelis, picoxystrobin**
Unassigned to class: **S2200, fenpyrazamine (V-10135), IKF-5411**

QoIs
Abound, Gem, pyraclostrobin, picoxystrobin
11
1990s

Polyoxins
Ph-D
19
1960s

Multi-site mode of action | Single-site mode of action | Reduced risk fungicides

Development of New Fungicides for Managing Almond Diseases

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Conventional Synthetic Fungicides – Pre-mixtures

- Inspire XT — 3+3
- Inspire Super — 3+9
- Adament, Quadris Top, Quilt Xcel — 3+11
- Pristine, Luna Sensation, Merivon, Q8Y78 — 7+11

3	DMIs
7	SDHIs
9	Anilinopyrimidines
11	QoIs

Natural Products and Biocontrols

Regalia, Cerebrocide, Ph-D organic, Actinovate

Natural products and a biocontrol that already are or potentially will be OMRI approved were evaluated for organic farming of almonds.

Management of Springtime Foliar Diseases of Almond

Blossom Blight and Shot Hole

Efficacy of Fungicides

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Brown rot:

- Numerous excellent treatments available
- Classes: DMIs (3), SDHIs (7), APs (9)
- Pre-mixtures of groups 3+11, 7+11, and 3+9
- New highly effective pre-mixtures: Luna Sensation, Merivon, Inspire Super

Gray mold:

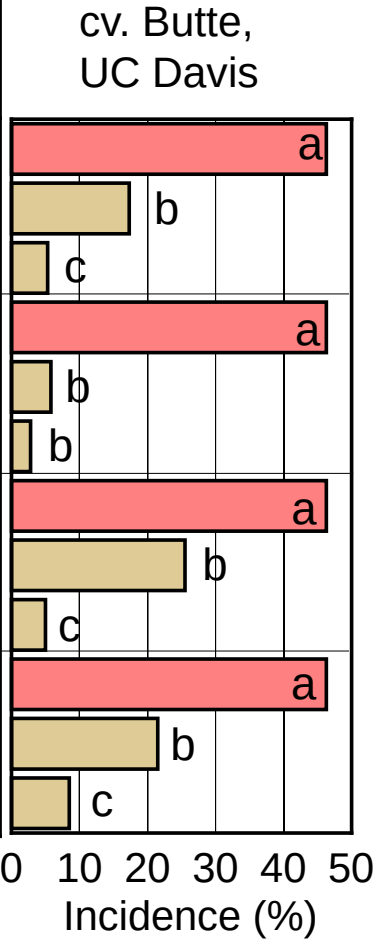
- Most effective treatments in the SDHIs (7) and APs (9)
- Effective pre-mixtures: 3+11, 7+11, and 3+9

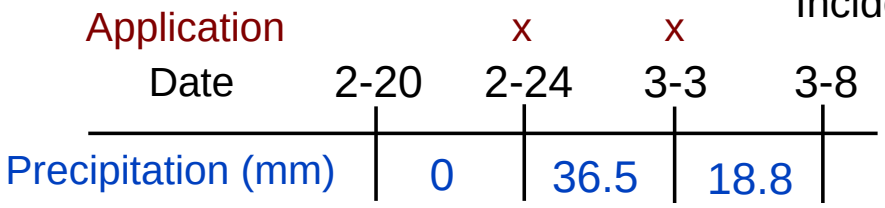
Shot hole:

- Most effective: pre-mixtures of 7+11 and 3+11, rotation treatments with 2 and M5 also effective
- Luna Sensation, Merivon, Inspire Super, Quadris Top, Bravo, & Rovral with minimal applications and under high-rainfall were effective

Brown Rot – Timing of Treatments

Treatment	20-30% bloom 2-24-11	80% bloom 3-3-11
Control	-	-
Luna Sensation 5 fl oz	@	-
Luna Sensation 5 fl oz	-	@
Control	-	-
Merivon 6.8 fl oz	@	-
Merivon 6.8 fl oz	-	@
Control	-	-
Quadris Top 14 fl oz	@	-
Quadris Top 14 fl oz	-	@
Control	-	-
Pristine 38WG 14.5 oz	@	-
Pristine 38WG 14.5 oz	-	@

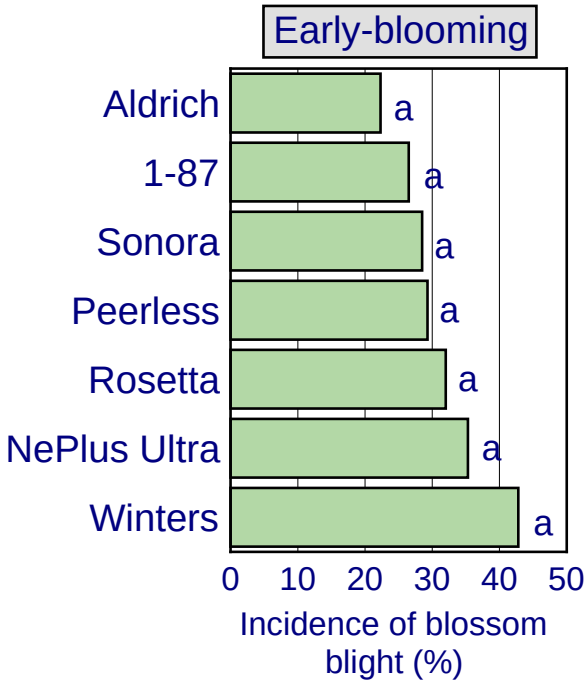


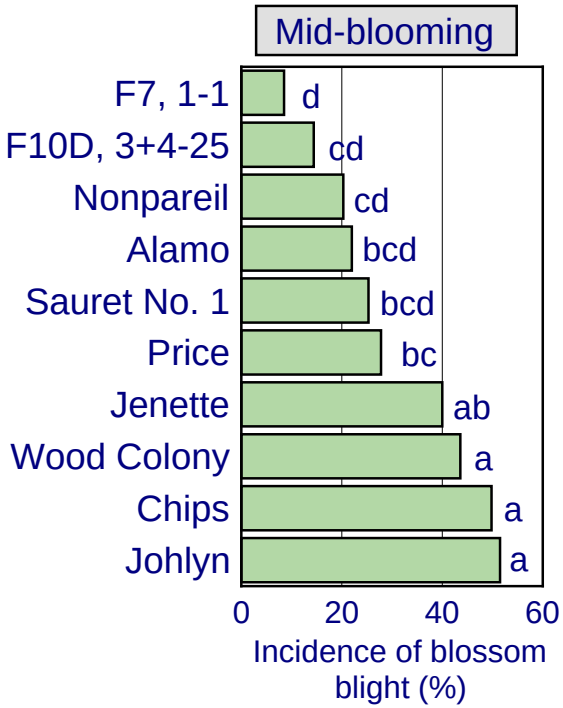


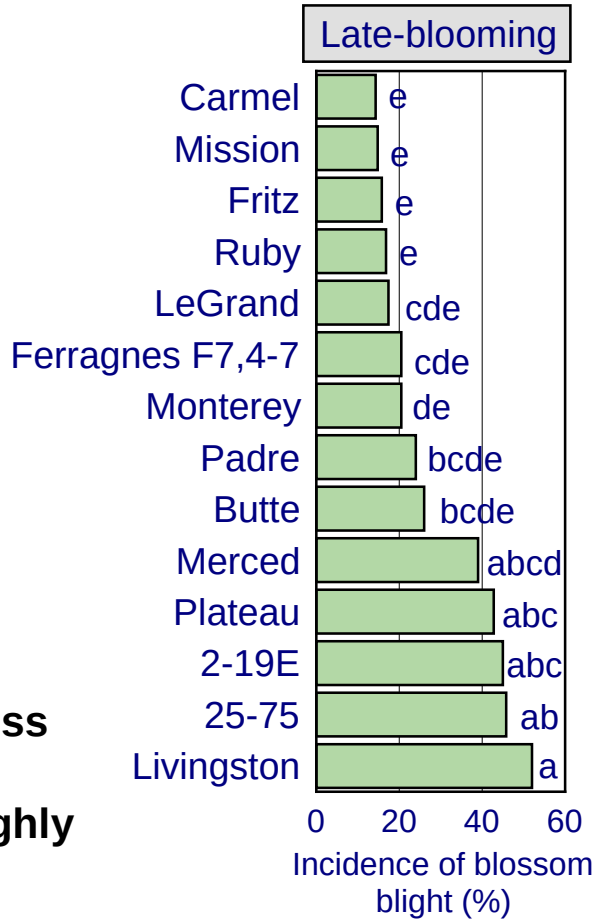
- **A single application at full bloom was generally more effective than a single application at early bloom even when high rainfall occurred before full bloom.**
- **In another trial on cv. Drake (very high disease pressure), 2 applications (at pink bud and full bloom) were more effective than a single application (at full bloom only).**

Natural Host Resistance Against Brown Rot Blossom Blight and Other Springtime Diseases

Natural Host Susceptibility of Almond Cultivars Against Blossom Blight - 2011







- **Blossom blight: With high-rainfall in 2011, some previously less susceptible cultivars (e.g., *Chips, Johlyn, Jennette*, *Plateau, Livingston*) showed a high incidence of disease, similar to highly susceptible cultivars such as Wood Colony and 25-75.**
- **Shot hole: Incidence was similar for most cultivars but severity was lowest for cvs. *Monterey, Carmel*, and *Fritz*.**
- **Bacterial blast: A range of susceptibilities**
  - ***Sonora* more susceptible than *Butte* in 2 studies**
  - ***Wood Colony, Merced, Mission, Ruby* were less susceptible.**

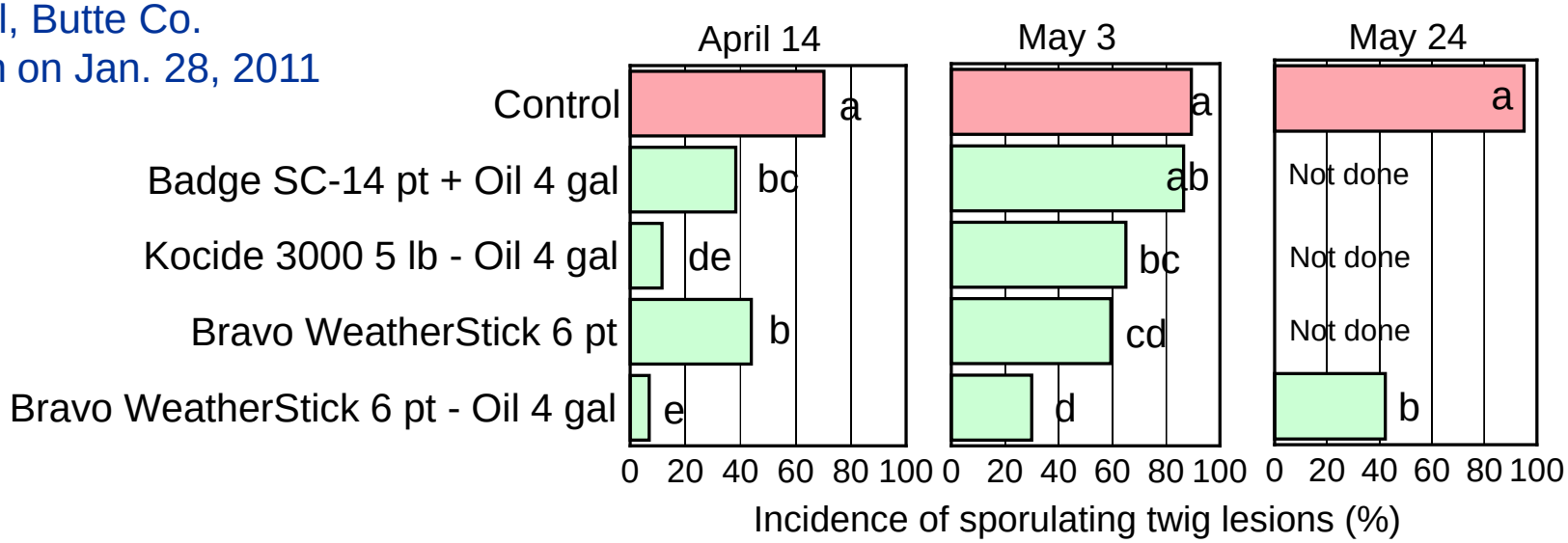
Management of Late-Spring/Summer Foliar Diseases of Almond

Scab, Alternaria Leaf Spot, Hull Rot

Management of Scab

1. Dormant Applications to Reduce Inoculum in The Spring

Cv. Carmel, Butte Co.
Application on Jan. 28, 2011



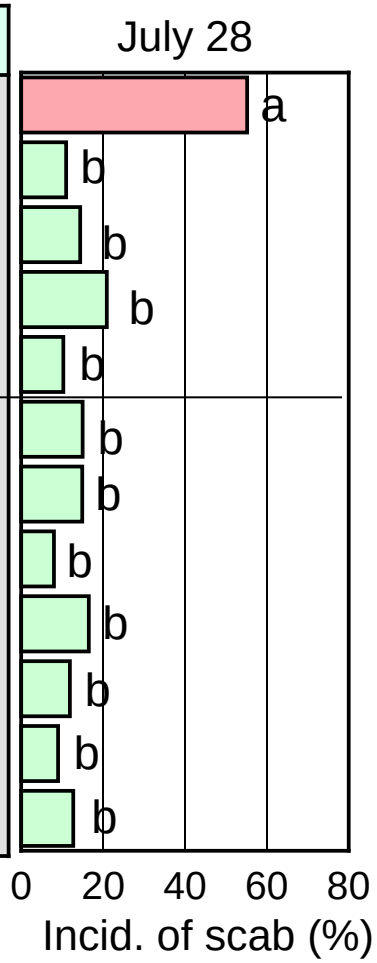
- **All treatments significantly reduced the incidence of sporulation into April**
- **Only <u>Bravo-Oil</u> had an extended efficacy into late spring.**
- **Thus, dormant applications can be highly effective in reducing and delaying production of primary inoculum**

Management of Scab

2. In-Season Applications

Cv. Peerless, Butte Co.

Treatments	4-6-11	5-24-11
Control	---	---
Ph-D 11.2DF org. form. 6.2 oz	@	@
Syllit 65W 32 oz	@	@
Fontelis (DPX LEM 17) 1.67SC 2 pt	@	@
Quash 50WG 3.5 oz	@	@
Adament 50WG 6 oz	@	@
Luna Sensation 5 fl oz	@	@
Luna Experience 6 fl oz	@	@
Inspire Super 20 fl oz	@	@
Quadris Top 14 fl oz	@	@
Pristine 38WG 14.5 oz	@	@
Merivon (BAS703) 6.8 fl oz	@	@



Almond scab can be effectively managed with single-site mode of action fungicides that are currently available, but these should be rotated with multi-site mode of action compounds (Bravo, Captan, Ziram).

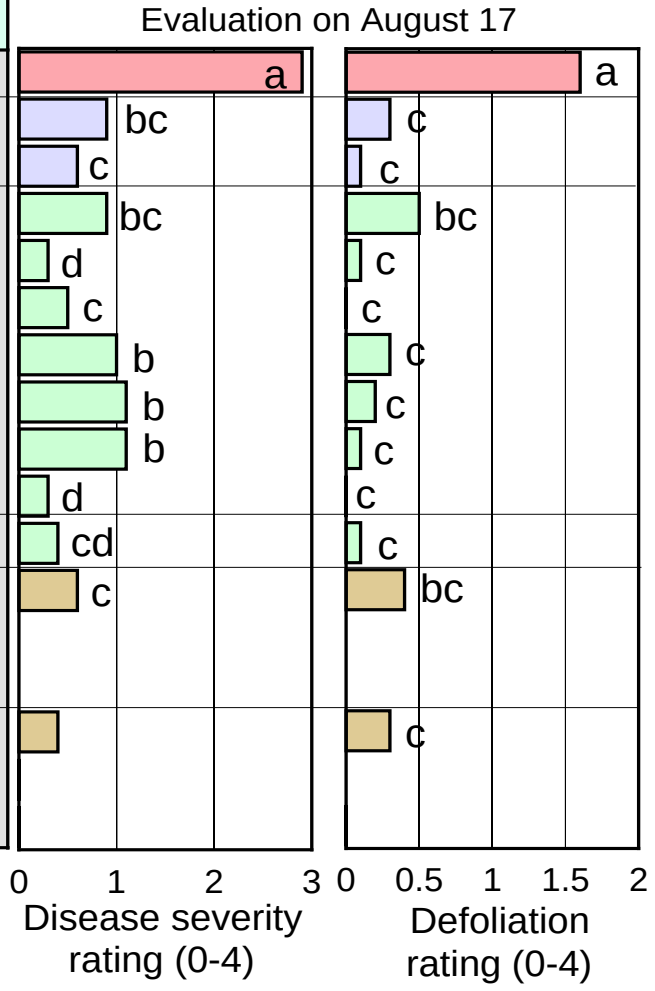
Management of Scab

- **New fungicides registered or planned for scab:**
  - Single-site MOA fungicides: Ph-D, Quash, Inspire, Syllit (*pending)*
  - Pre-mixtures: Inspire Super, Quilt Xcel, Quadris Top, as well as Luna Sensation & Merivon (*pending)*
- **Fungicide programs:**
  - A highly effective three-spray program should include dormant applications and two petal-fall (around twig infection sporulation) applications with chlorothalonil, possibly mancozeb, captan, or ziram (i.e. multi-site fungicides with low resistance potential).
  - Because maneb has been voluntarily canceled (2008/2009), mancozeb (e.g., Dithane) fungicides are being tested and are planned for future registrations.
  - **Single-site fungicides should not be applied once disease is developing**.
- **Cultural practices: IPM and the Disease Triangle**

Management of Alternaria Leaf Spot – Field Efficacy Trials

cv. Monterey, Kern Co.

Treatment	5/13	6/2	6/23
Control	---	---	---
CX10440 (polyoxin-D) 3.75 fl oz	@	@	@
Ph-D 11.2DF org. 6.2 oz	@	@	@
Quash 50WG 3 oz	@	@	@
Luna Experience 6 fl oz	@	@	@
Luna Sensation 5 fl oz	@	@	@
Inspire Super SC 20 fl oz	@	@	@
Quadris Top 14 fl oz	@	@	@
Pristine 38WG 14 oz	@	@	@
BAS703 (Merivon) 6.8 fl oz	@	@	@
Ph-D org. 6.2 oz + Quash 3 oz	@	@	@
Ph-D org. 6.2 oz	@	---	---
Quash 3 oz	---	@	---
Ph-D + Quash 3 oz	---	---	@
Ph-D org. 6.2 oz	@	---	---
Inspire Super 20 fl oz	---	@	---
BAS700 (Xemium) 4.5 fl oz	---	---	@



Data shown for this trial are representative for several trials conducted in 2011

Management of Alternaria Leaf Spot – Field Efficacy Trials

Tree defoliation evaluated in August

Control

Ph-D, Luna Sensation, Quadris Top, Merivon

cv. Monterey, Kern Co.

Management of Alternaria

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Most effective treatments:

- Mixtures of the Group 19 Ph-D (polyoxin-D) and the Group 3 fungicides (i.e., Inspire, Quash).

Other new fungicides with high activity:

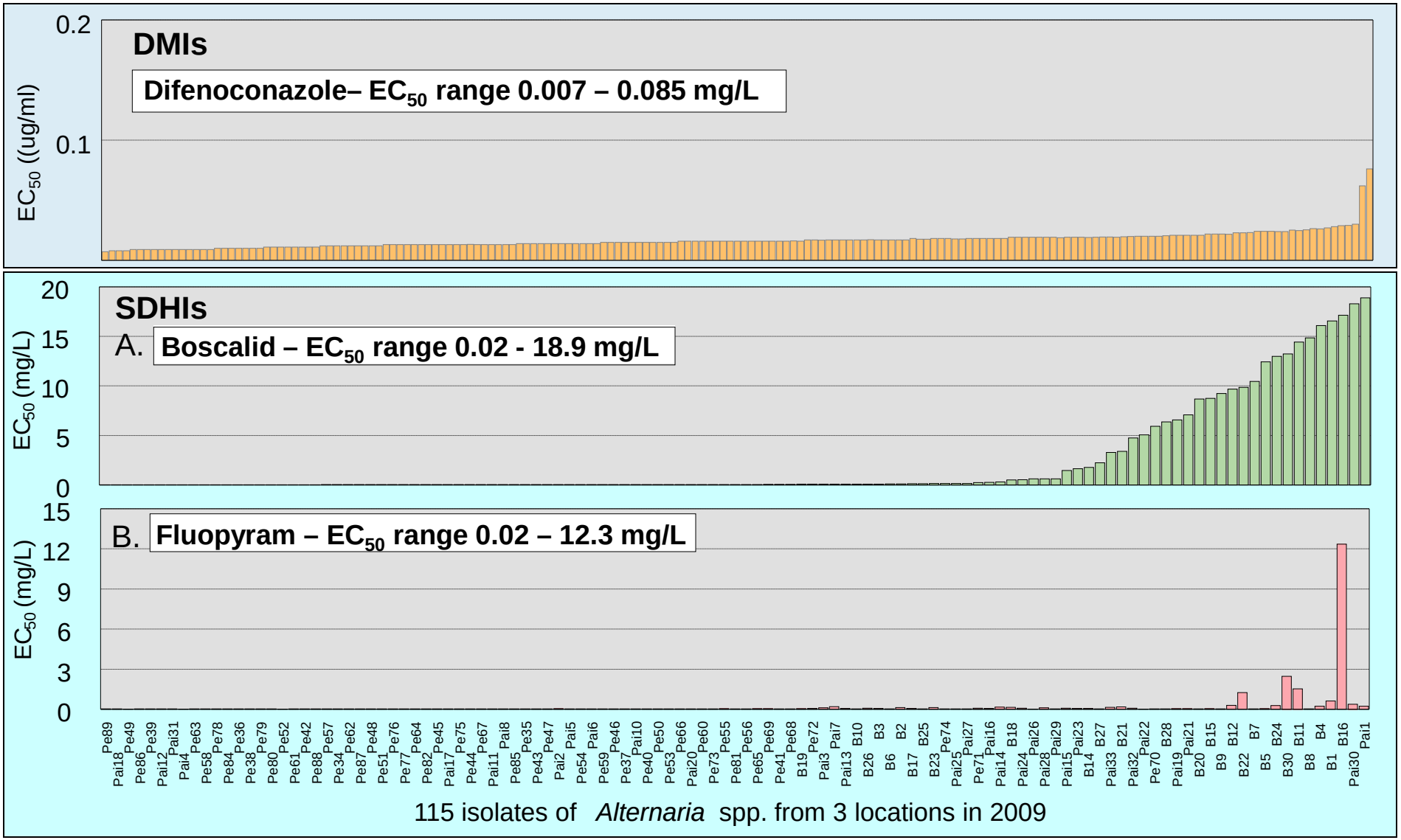
- Luna Sensation, Adament, Quadris Top, Quilt Excel, Merivon. These all have a QoI component and thus, will exacerbate QoI resistance.

Fungicide resistance:

- Resistance against QoIs is common, resistance against older SDHIs (i.e., boscalid) high at some locations
- Cross resistance within QoIs (Abound, Gem, etc.)
- Newer SDHIs (fluopyram, fluxapyroxad) more effective than older ones (boscalid), but some cross-resistance occurs.

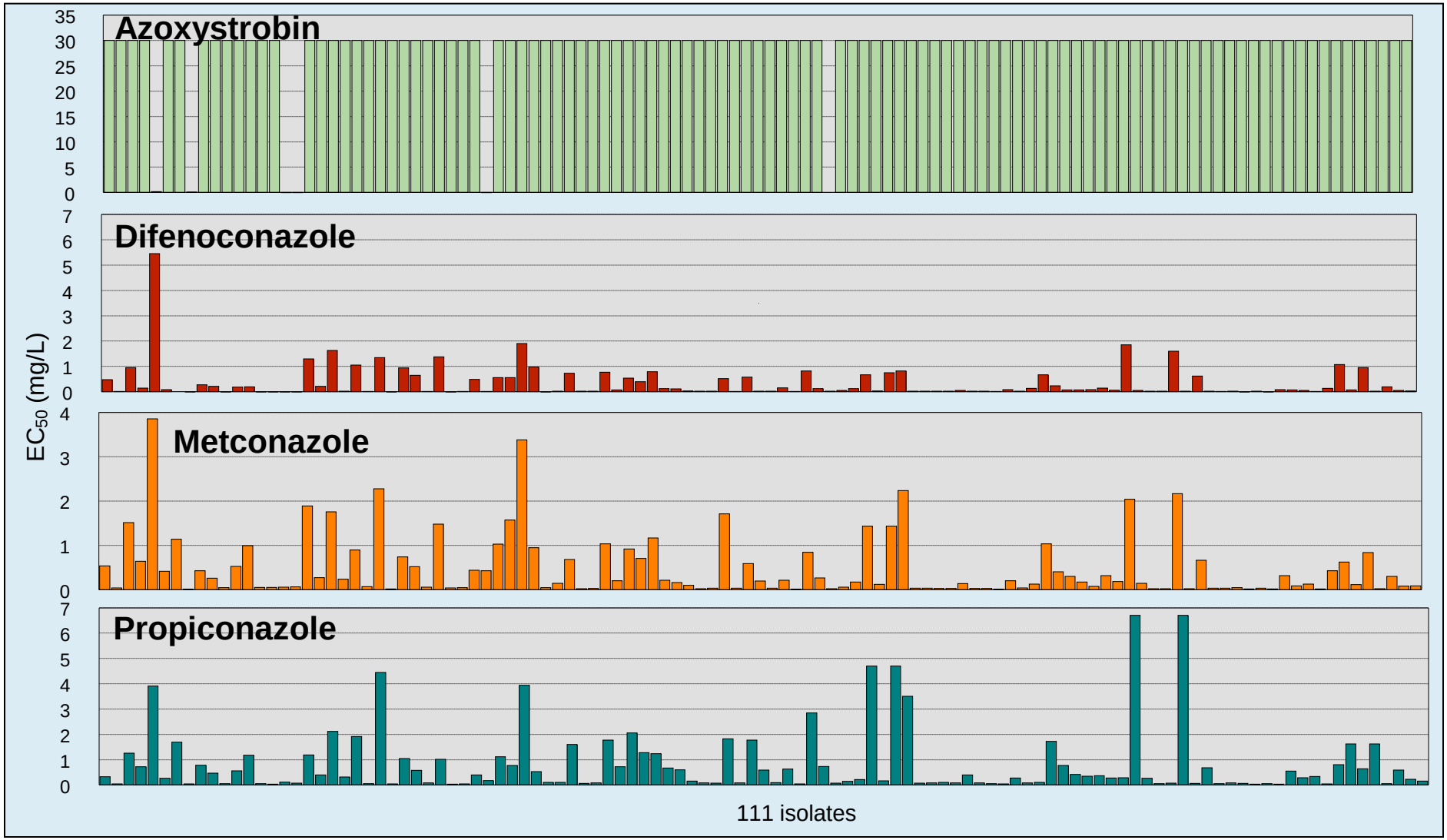
Fungicide Sensitivity Studies and Population Variability as an Indicator of Resistance Potential

In Vitro Sensitivity of *Alternaria* spp. Against DMIs and SDHIs



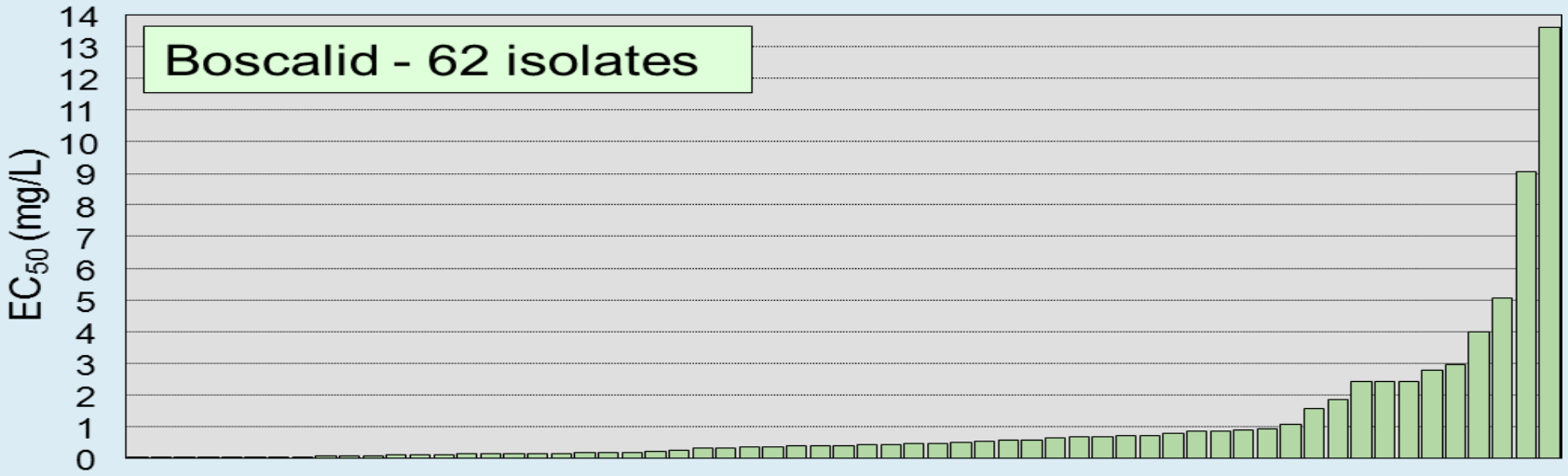
Isolate order in both graphs is the same.

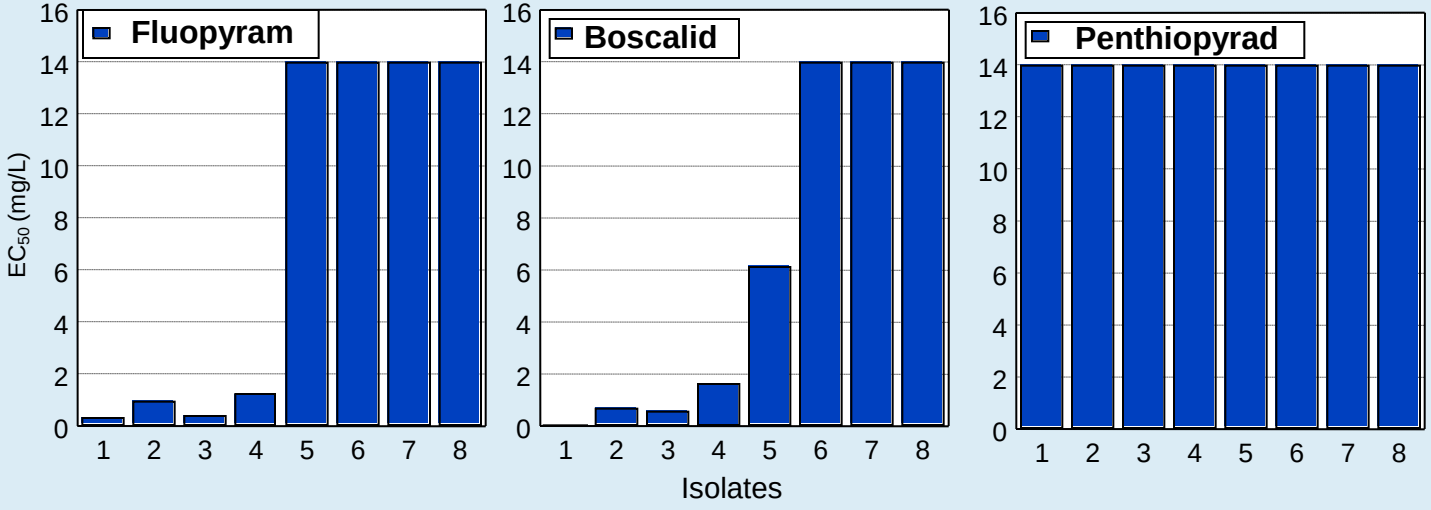
In Vitro Sensitivity of *Cladosporium carpophilum* Against QoIs and DMIs



Isolate order in all graphs is the same.

In Vitro Sensitivity of *Cladosporium carpophilum* Against SDHI Fungicides





* - Note that isolates order is the same in the three graphs.

In Vitro Sensitivity of Cladosporium and *Alternaria* spp. Against DMIs and SDHIs - Summary

Alternaria:

- **DMIs:** All isolates evaluated were sensitive with a narrow range
- **SDHIs:** High levels of resistance against boscalid at some locations
  - Cross resistance between the older SDHI boscalid and newer SDHIs (e.g., fluopyram) for some isolates.

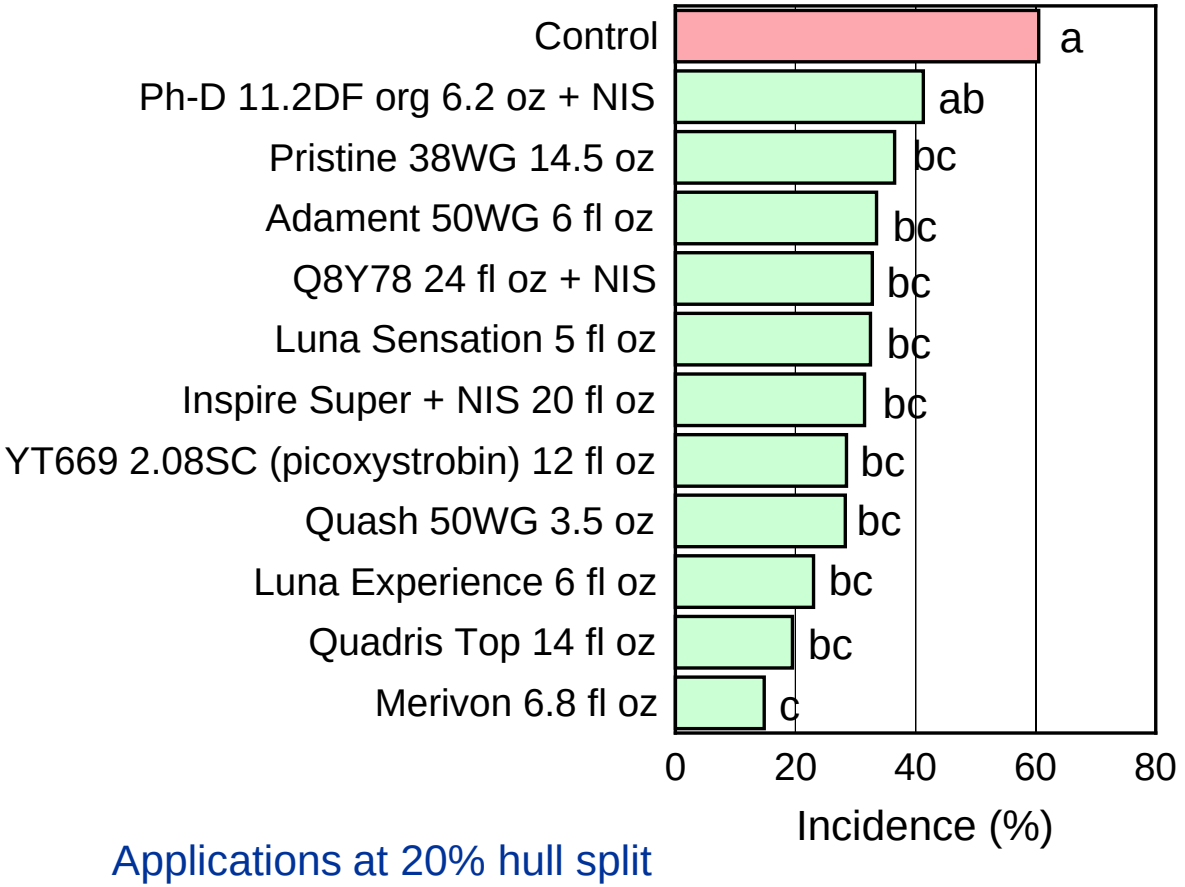
Scab:

- **DMIs and SDHIs**: A wide and continuous range of sensitivities
- Generally, isolates less sensitive to one DMI or SDHI were also less sensitive to other members of the class
- Thus, many of the isolates naturally resistant to DMIs
- High-resistance to **QoI** fungicides was determined to be based on the G143 mutation as in many other fungi.

Management of Hull Rot
cv. Nonpareil, Colusa Co. - *R. stolonifer* and *M. fructicola*

Rhizopus stolonifer

Monilinia fructicola



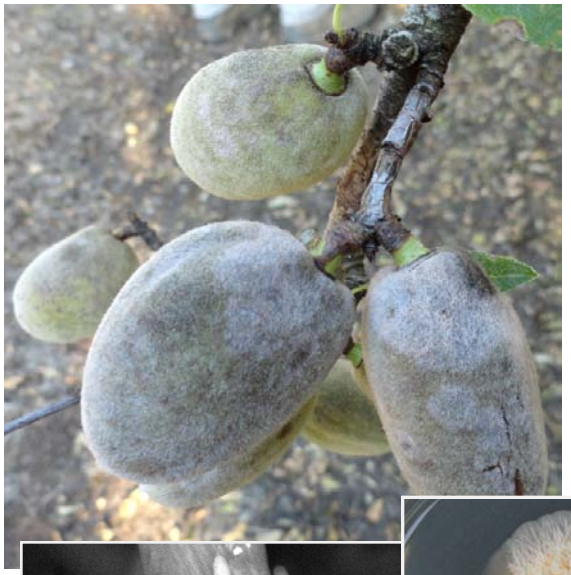
Applications at 20% hull split

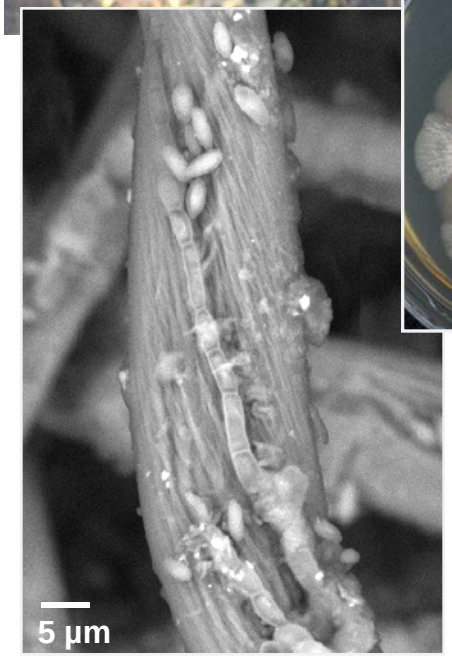
- **Fungicide treatments effective against hull rot caused by *R. stolonifer***
- **In a timing comparison, treatments with Luna Sensation, Quadris Top, or Quash at early split were similarly effective to treatments at 20% split or to treatments at both timings.**

Management of Hull Rot

- Knowledge on the management of hull rot is accumulating.
- Fungicide treatments ***are effective*** in reducing hull rot caused by *R. stolonifer*, but ***not*** by *M. fructicola*.
  - For *Rhizopus* hull rot, no differences in application timings possibly because of the long hull split duration within an orchard. Fungicides applied most effectively during the stages when susceptibility is high and with NOW applications.
  - For *Monilinia* hull rot, earlier application timings need to be tested.
- PGRs (e.g., ethephon) that were evaluated in 2010 possibly can be used to accelerate hull rot for late-maturing varieties.
- For the most effective integrated management of hull rot, hull split should be induced simultaneously with proper water management (i.e., deficit irrigation).

Etiology of a New 'Powdery Mildew-like' Almond Disease





Culture of *Acremonium* sp.

- Powdery mildew-like symptoms on almond fruit have been observed at numerous locations in recent years.
- A high incidence at one location in 2011.
- A fungus was consistently isolated and identified by morphology and DNA sequence analysis: *Acremonium* sp.
- Inoculations are planned for 2012 to verify pathogenicity of the fungus (Koch's postulates).
- The disease is most likely not a powdery mildew but is caused by *Acremonium* sp. that produces white to orangish growth similar to mildew on fruit.
- Economic importance of this pathogen is not known currently.

On-line Resources on Fungicide Use

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EFFICACY AND TIMING OF FUNGICIDES, BACTERICIDES, AND BIOLOGICALS FOR DECIDUOUS TREE FRUIT, NUT, STRAWBERRY, AND VINE CROPS 2012

ALMOND
APPLE AND PEAR
APRICOT
CHERRY
GRAPE
KIWIFRUIT
PEACH
PISTACHIO
PLUM
PRUNE
STRAWBERRY
WALNUT

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UC Kearney Agricultural Center
www.uckac.edu/plantpath

Statewide IPM Program
www.ipm.ucdavis.edu

Insect and Mite Management Update

Frank Zalom, UC Davis

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Key Insect and Mite Arthropod Pests

Key pests?

- A 'key pest' is one that requires some sort of intervention almost every year.
- What is a 'key pest' often depends on location.
- Management of pests can affect other pests.

Navel Orangeworm

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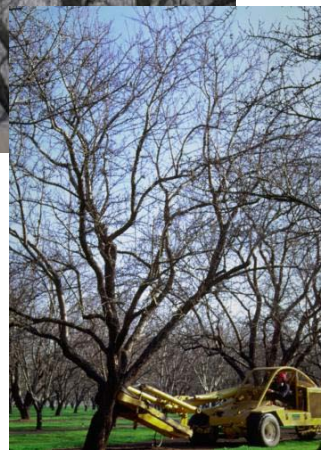
Management

- Cultural Controls - winter sanitation, early harvest and rapid pick up of nuts
- Monitoring
- Chemicals controls
    - Conventional products
    - Less-disruptive products
    - Pheromone mating disruption

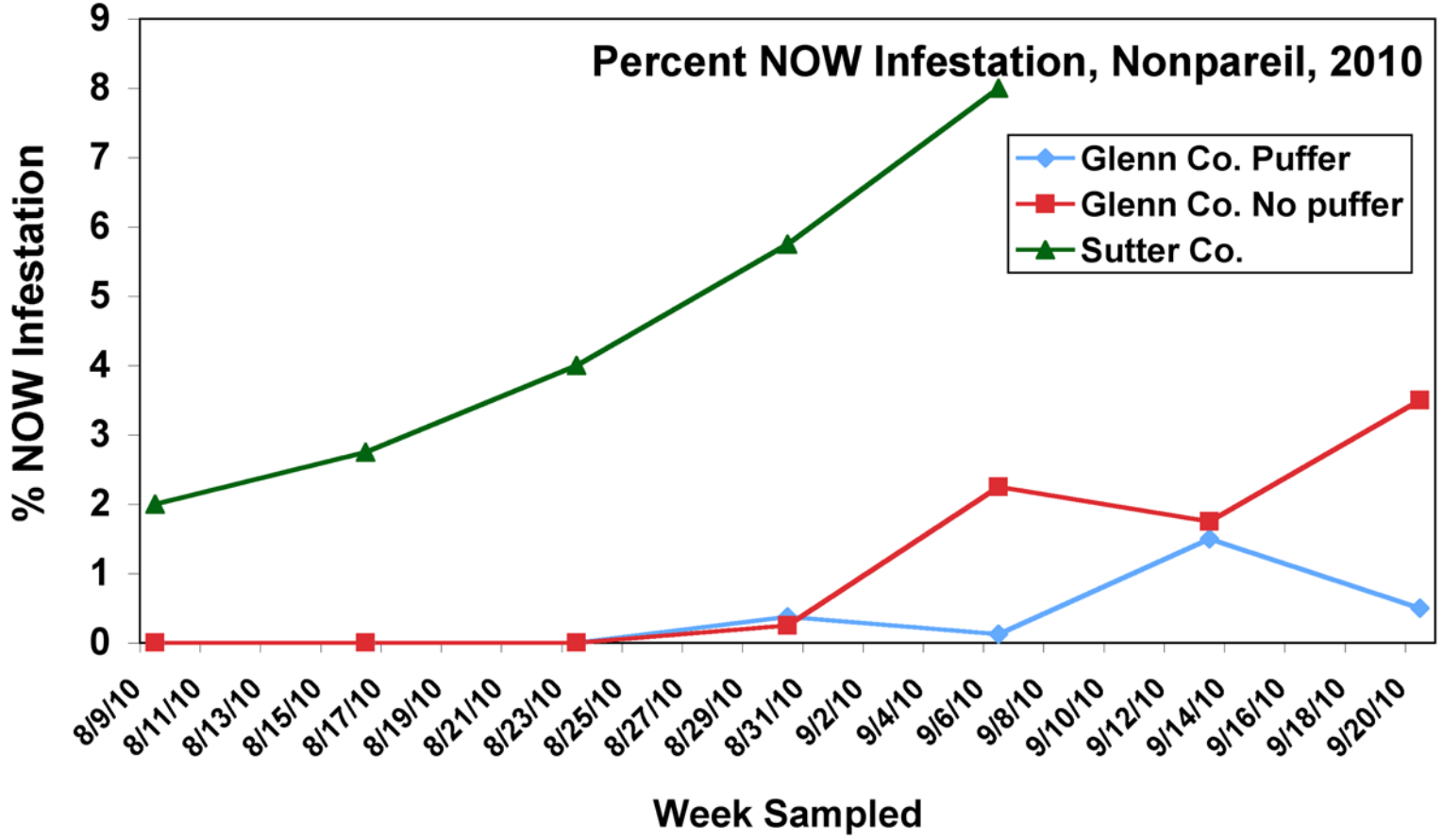
Navel Orangeworm

Cultural Controls



Navel Orangeworm

Early Harvest

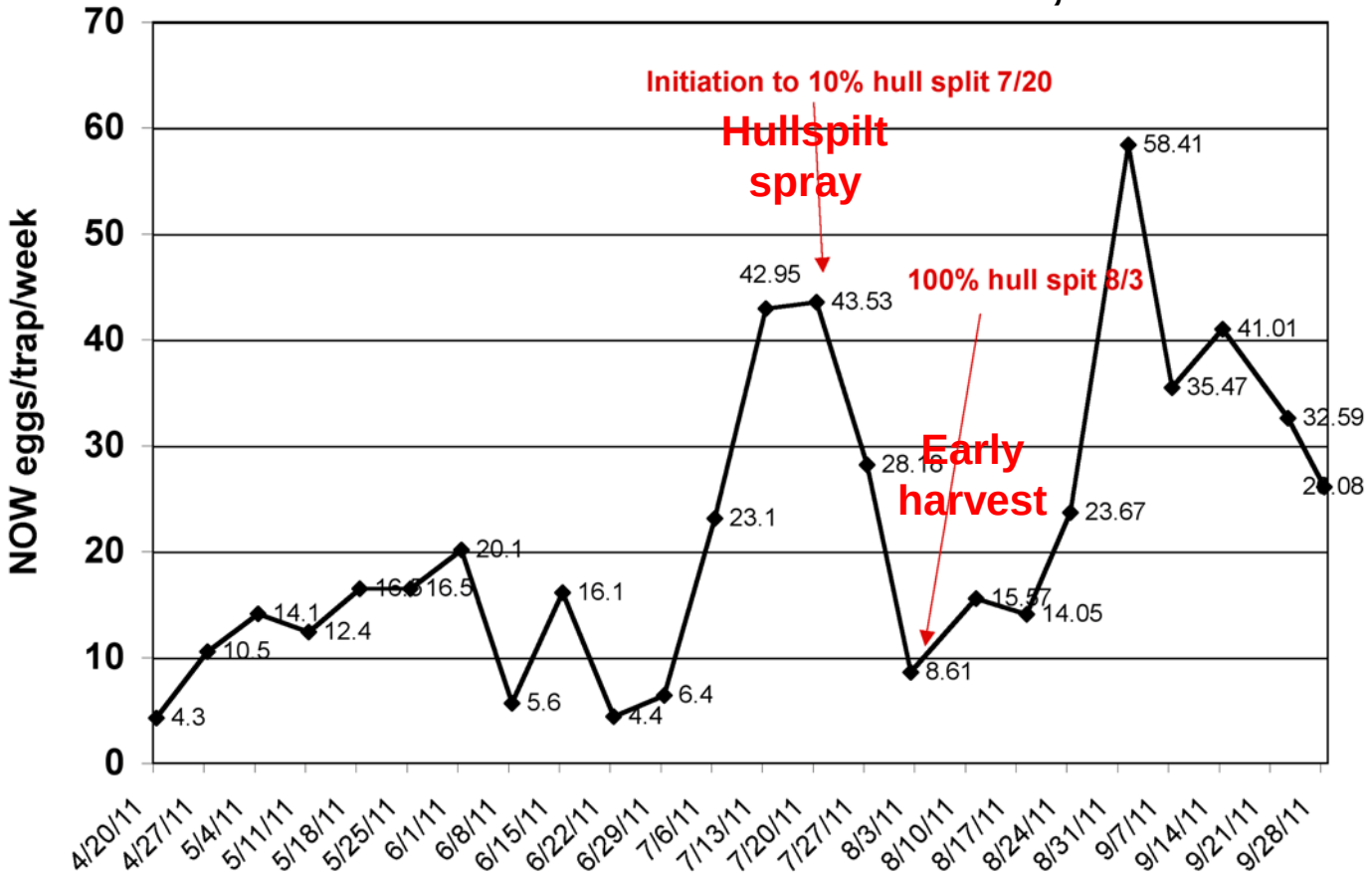


Navel Orangeworm

Monitoring

A Sustainable Farming Project field day

Navel Orangeworm Traps, 13 Orchards
Westside Fresno and Madera Co., 2011



Walt Bentley, UCIPM

Navel Orangeworm

Chemical Controls

- Conventional products - more disruptive
  - Organophosphates (Lorsban, Dibrom, Imidan)
  - Pyrethroids -
    - Asana
    - Pounce and Ambush
    - Brigade, Bifenture, Athena, etc.
    - Warrior, Volium Express, Lambda-Cy, etc.
    - Danitol

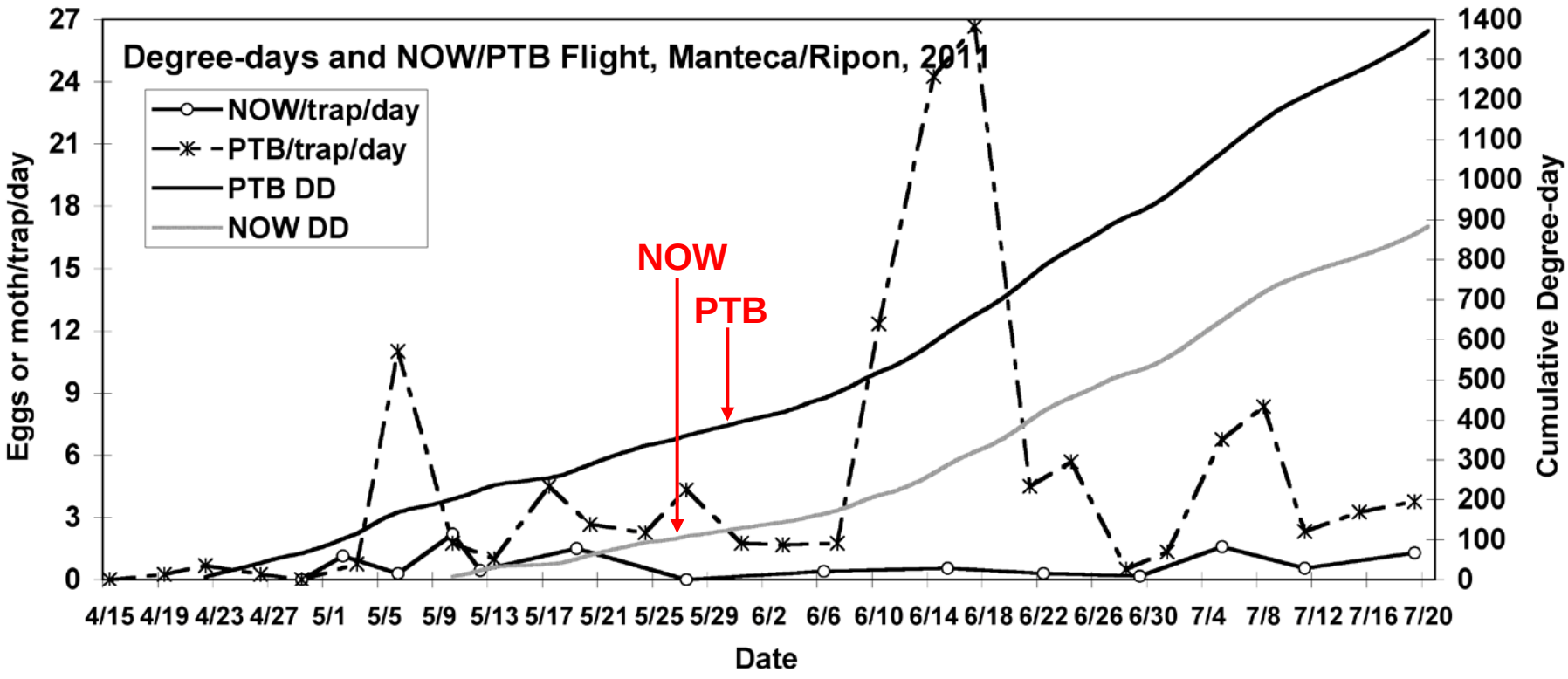
Navel Orangeworm

Chemical Controls

- Conventional products - less disruptive ??
  - Avermectins (Proclaim)
  - Diacylhydrazines (Intrepid, Belt, Tourismo)
  - Diamides (Altacor)
  - Benzoylureas (Dimilin)
  - Spinosyns (Delegate, Success, Entrust)
  - *Bacillus thuringiensis*

Navel Orangeworm

May Spray Timing



Navel Orangeworm

May Spray Timing

Proportion of navel orangeworm infested mummies, Ripon, 2011

Treatment	Rate (form/acre)	Application date	Mean ± SD[1]	
Control (water)			10.9 ± 15.7	ABCD
Dipel*	1 lb. (x 2 appls)	5/9 & 5/27	4.9 ± 9.3	DE
Dimilin 2L	12 oz	5/25	14.3 ± 11.5	A
diflubenzuron (generic)	12 oz	5/25	11.0 ± 11.8	ABC
Lorsban	4 pt	5/25	0.0 ± 0.0	E
Intrepid 2F***	16 oz	5/10	1.7 ± 3.7	E
Intrepid 2F***	16 oz	5/25	1.5 ± 3.2	E
Intrepid 2F***	16 oz	5/27	0.9 ± 2.6	E
Delegate 25WG ***	4.5 oz	5/10	2.6 ± 4.2	E
Delegate 25WG***	4.5 oz	5/25	2.2 ± 4.6	E
Delegate 25WG ***	4.5 oz	5/27	0.7 ± 2.3	E
Altacor 35WDG***	4 oz	5/10	0.8 ± 2.4	E
Altacor 35WDG***	4 oz	5/25	1.9 ± 4.2	E
Altacor 35WDG***	4 oz	5/27	0.0 ± 0.0	E
Assail 70WP + Lambda-Cy 11.4EC	4.1 oz + 2.56 oz	5/25	4.4 ± 6.1	CDE
Assail 70WP + Lambda-Cy 11.4EC	4.1 oz + 5.12 oz	5/25	3.5 ± 8.3	E
Belt 4SC**	4 oz	5/27	2.7 ± 4.6	E

[1] Means followed by the same letter do not differ significantly at *P*=0.05 by Student's t-test following arcsine transformation.
[2] Mixed with Dyne-Amic at 0.25% v/v
[3] Mixed with Induce at 1.0% v/v

Navel Orangeworm

Proportion of navel orangeworm infested mummies, Ripon, 2010

Treatment	Chemical	Rate (form/ac)	Date	DD	Proportion infested nuts Mean ± SD[1]			
Control (water)			5/13	99 NOW	0.14	±	0.1	A
Belt[2]	flubendiamide	4.0 oz	5/13	99 NOW	0.01	±	0.0	B
Tourismo[2]	flubendiamide, buprofezin	14.0 oz	5/13	99 NOW	0.01	±	0.0	B
Intrepid 2F[3]	methoxyfenozide	16 oz	4/30	0 NOW	0.00	±	0.0	B
Intrepid 2F[3]	methoxyfenozide	16 oz	5/13	99 NOW	0.03	±	0.1	B
Intrepid 2F[3]	methoxyfenozide	16 oz	5/31	441 PTB	0.02	±	0.0	B
Delegate[3]	spinetoram	6.4 oz	4/30	0 NOW	0.01	±	0.0	B
Delegate[3]	spinetoram	6.4 oz	5/13	99 NOW	0.01	±	0.0	B
Delegate[3]	spinetoram	6.4 oz	5/31	441 PTB	0.01	±	0.0	B
Altacor 35WG[3]	chlornitraniliprole	4.0 oz	4/30	0 NOW	0.00	±	0.0	B
Altacor 35WG[3]	chlornitraniliprole	4.0 oz	5/13	99 NOW	0.02	±	0.0	B
Altacor 35WG[3]	chlornitraniliprole	4.0 oz	5/31	441 PTB	0.02	±	0.0	B
Proclaim	emamectin benzoate	4.0 oz	5/13	99 NOW	0.01	±	0.0	B
Assail 30SG[2]	acetamiprid	6.4 oz	5/13	99 NOW	0.10	±	0.1	A
Voliam Xpress	lamda-cyhalothrin, chlorantraniliprole	7.0 oz	5/13	99 NOW	0.01	±	0.0	B
Brigade 10WP	bifenthrin	0.5 lb	5/13	99 NOW	0.01	±	0.0	B
Bifenture 10DF[2]	bifenthrin	16 oz	5/13	99 NOW	0.00	±	0.0	B
Lambda-Cy 1EC	lambda-cyhalothrin	5.0 oz	5/13	99 NOW	0.00	±	0.0	B

• Means followed by the same letter do not differ significantly at *P*=0.05 by Student's t-test following arcsin transformation

[1] LI-700 added @ 0.5% v/v

[2] Dyne-Amic added @ 0.25%% v/v

[3] Induce added @ 0.25% v/v

Navel Orangeworm

Hulls plit S pray

Almonds Ovicidal and Neonate Activity

Treatment	Total Eggs	Living	% Survival	Reduction*
Control	2,300	1,133	49.26 A	
Delegate 6.4 oz	3,000	401	13.37 B	72.86%
Delegate 3.2 oz.+ Intrepid 9 oz	2,050	70	3.41 C	93.08%
Intrepid 18 oz	1,800	33	1.83 D	96.29%
Altacor 4 oz.	1,550	55	3.54 C	92.81%

Treatment	Total Eggs	Living	% Survival	Reduction*
Control	1,400	1,226	87.57 A	
Intrepid	3,800	29	0.76 B	99.132%

Eggs pinned on nuts and larval survival assessed

J. Siegel, USDA-ARS

Navel Orangeworm

Hullsplit Spray - Residual Activity

Insecticide	Day after spray	Percent Mortality	Percent Reduction	Eggs
Belt (4 oz) Carbomin Zinc 7.5% (20 oz), First Choice Narrow Range 415 Spray Oil (20 oz)	6	98.60	84.01	1,000
Belt (4 oz) Carbomin Zinc 7.5% (20 oz), First Choice Narrow Range 415 Spray Oil (20 oz)	9	97.47	71.58	950
Belt (4 oz) Carbomin Zinc 7.5% (20 oz), First Choice Narrow Range 415 Spray Oil (20 oz)	14	99.28	91.78	1,800
Altacor (4.5 oz) Tucked Carbomin Zinc 7.5% (20 oz), First Choice Narrow Range 415 Spray Oil (20 oz)	14	97.33a	69.51	3,300

Split nuts collected and eggs introduced in the lab; measured survival to adult

J. Siegel, USDA-ARS

Navel Orangeworm

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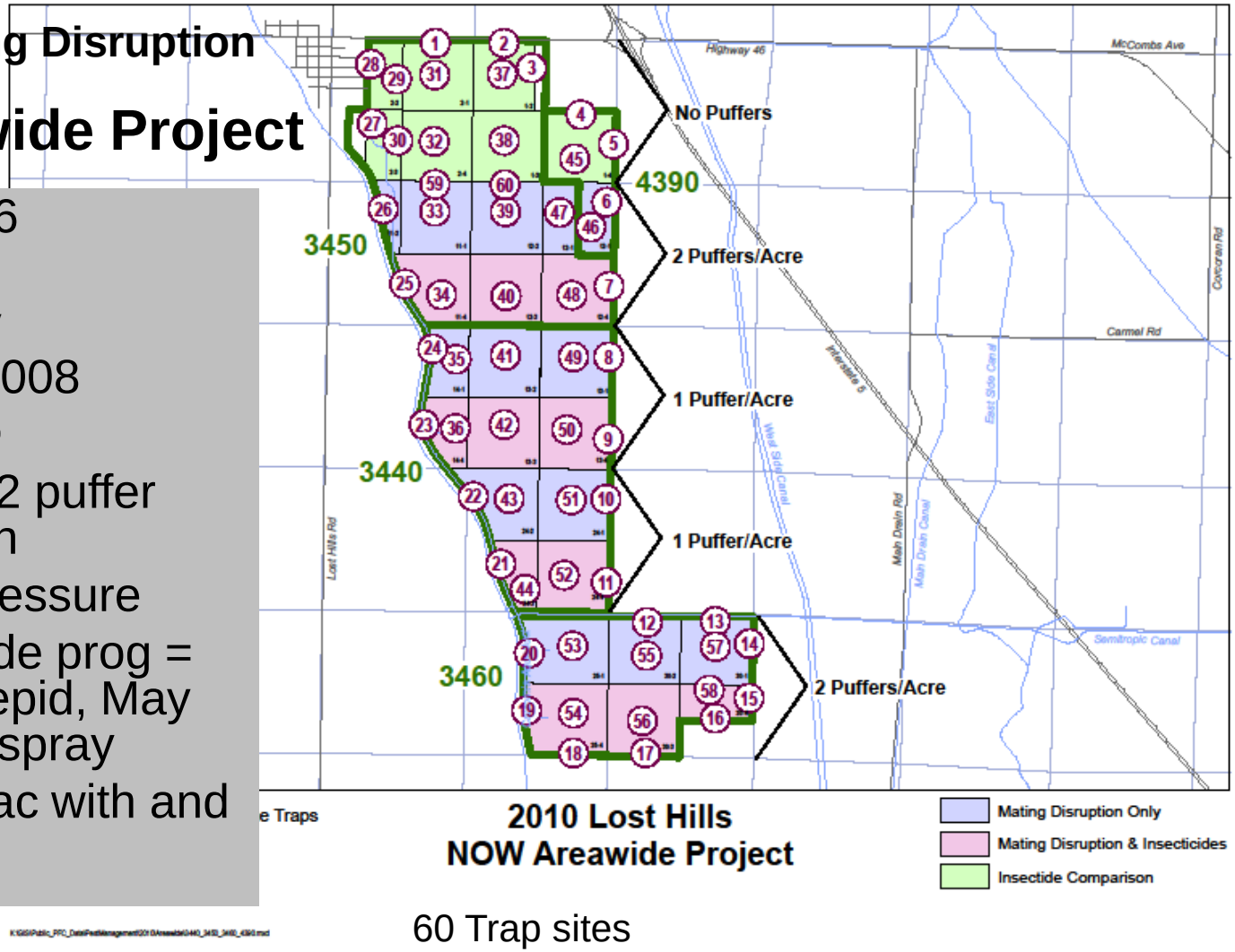
Pheromone Mating Disruption

Lost Hills Areawide Project

- Started in 2006
  - 1800 ac MD
  - 800 ac conv
- Expanded in 2008
  - 2800 ac MD
  - Added 1 vs 2 puffer comparison
- Low to mod pressure
- Conv insecticide prog = 2 appls of Intrepid, May spray and HS spray
- 1 or 2 puffers/ac with and without Conv

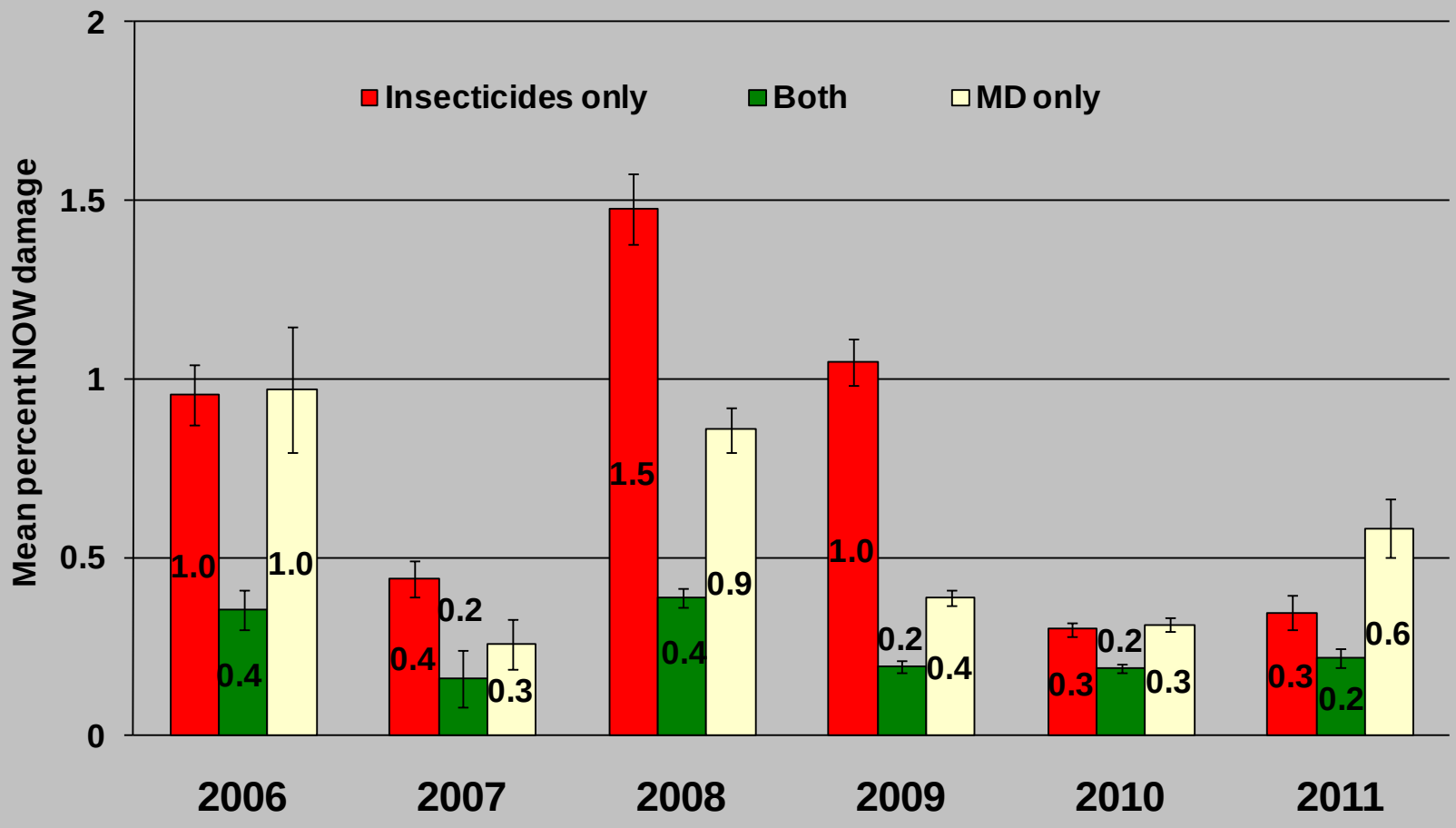


60 Trap sites

B. Higbee, Paramount Farming Co.

Lost Hills Areawide NOW MD Project

Processor/huller samples - All Varieties

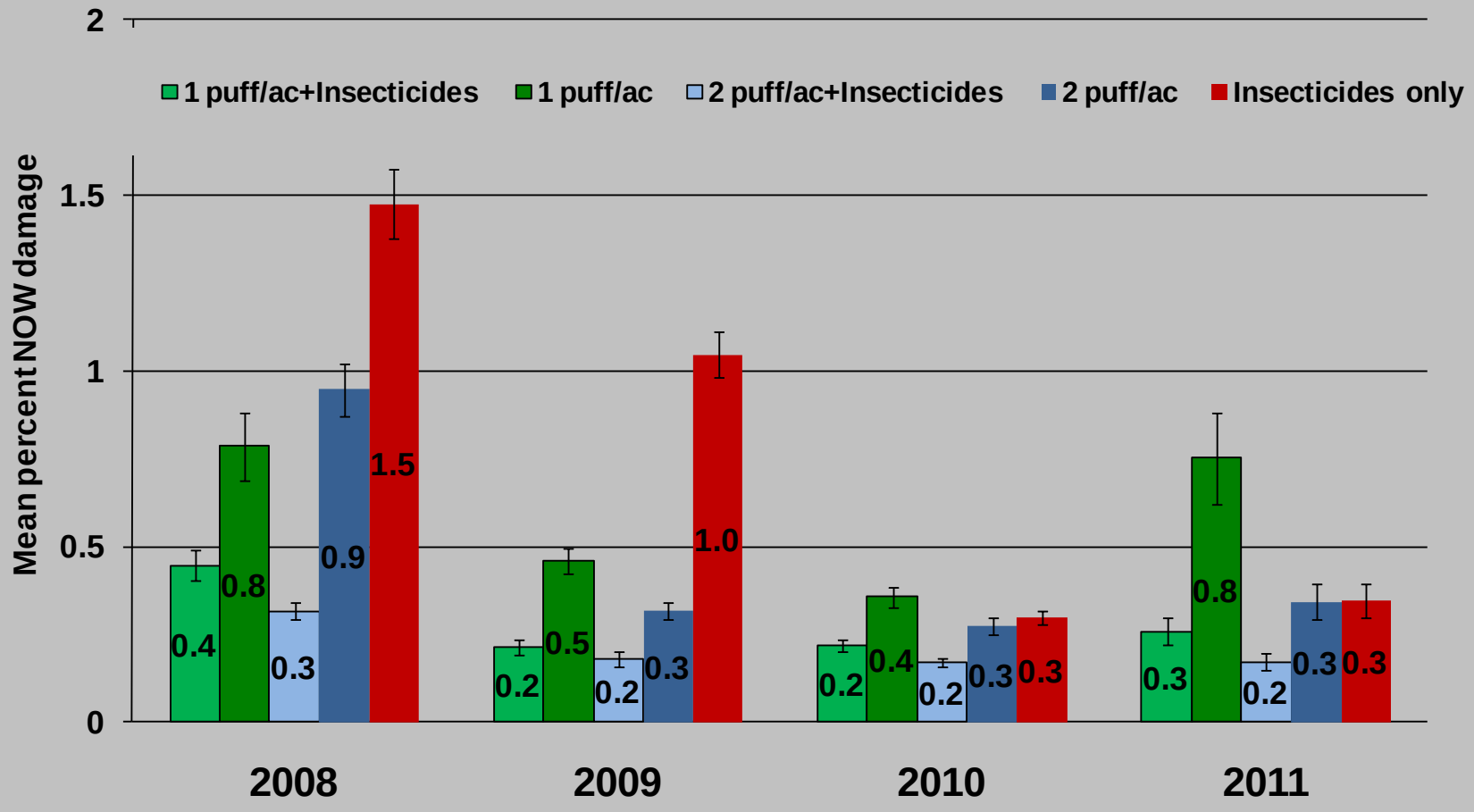


The combination of MD + insecticides is better than either alone

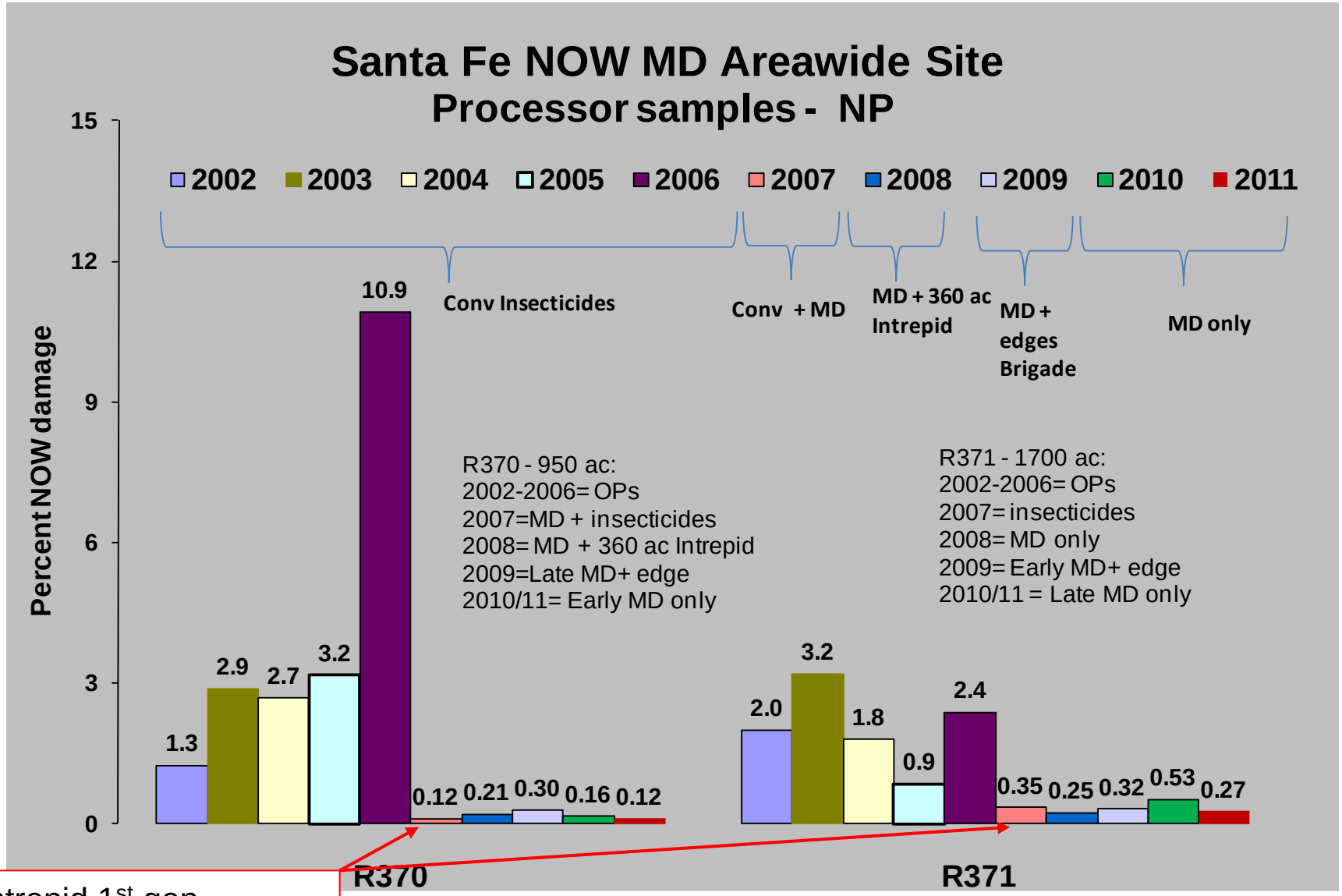
B. Higbee, Paramount Farming Co.

Lost Hills Areawide NOW MD Project

Processor/huller samples - All Varieties



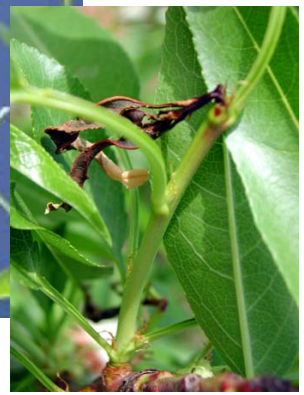
B. Higbee, Paramount Farming Co.



Intrepid 1st gen
Intrepid + Lorsban HS
Brigade post-HS

B. Higbee, Paramount Farming Co.

Peach Twig Borer

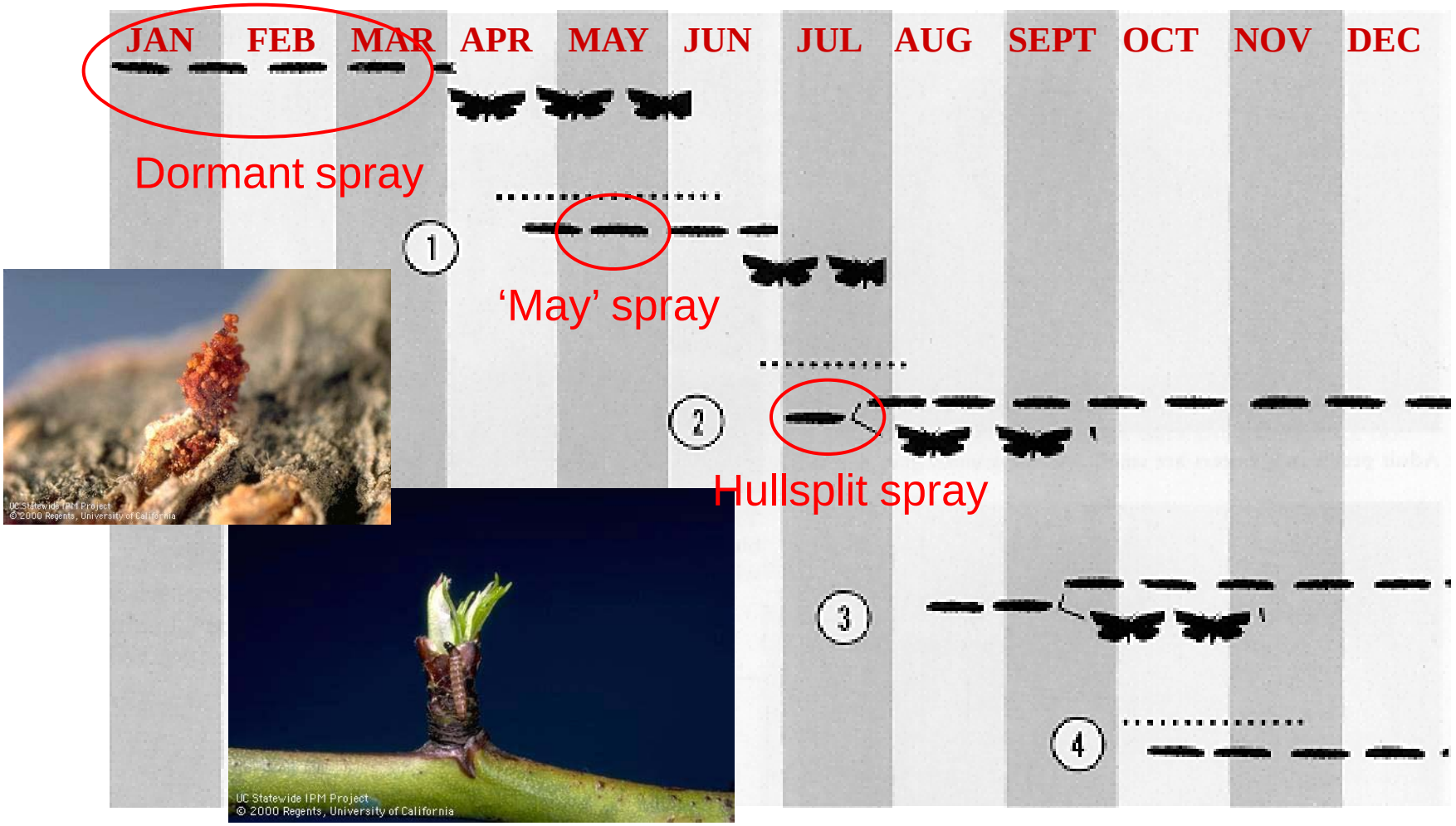


Peach twig borer

Anarsia lineatella

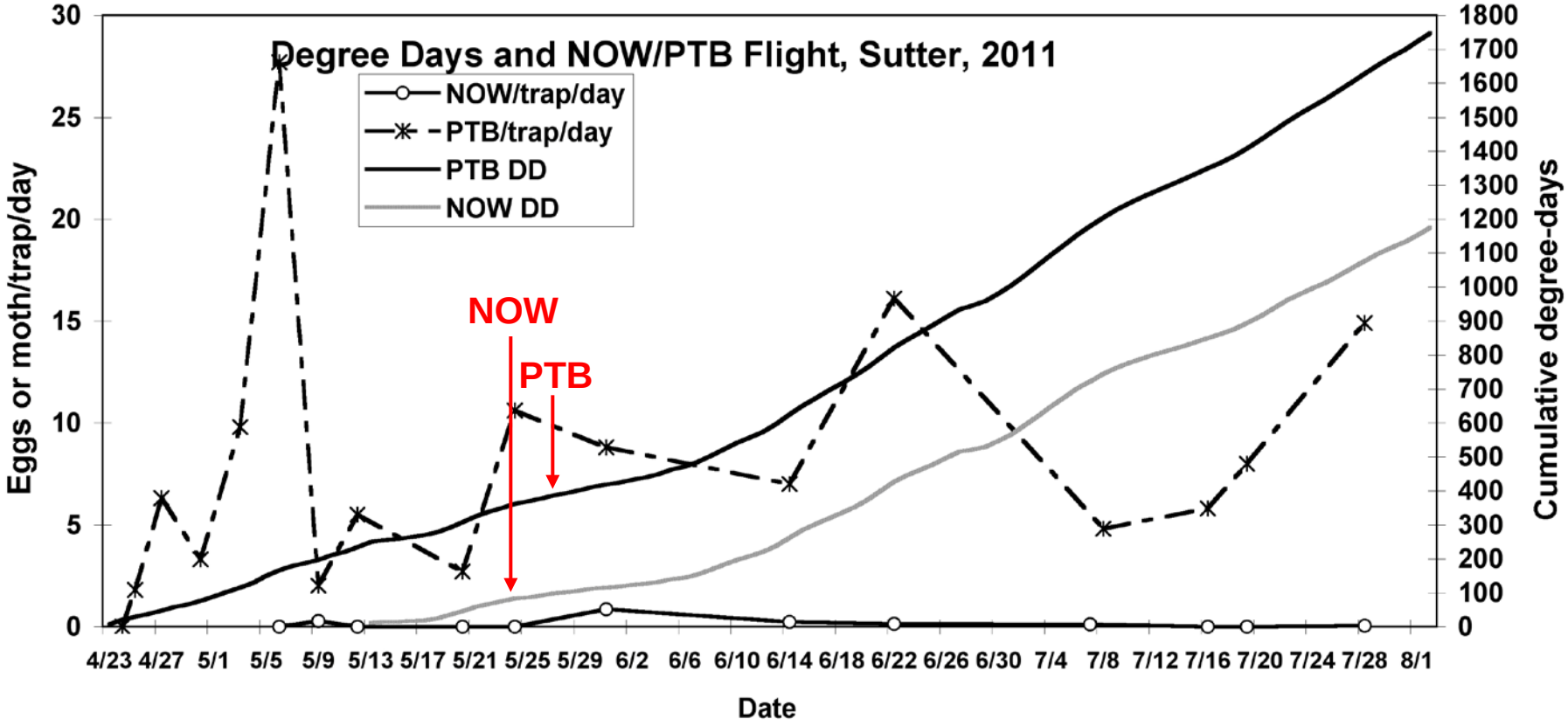
Peach Twig Borer

Monitoring



Peach Twig Borer

Monitoring



Peach Twig Borer

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Mean (±SD) peach twig borer shoot strikes per tree, Sutter, 2011

Treatment	Rate	Application date	PTB strikes/tree* Mean ± SD	
untreated	na	na	5.4 ± 4.8	A
Dipel[1]	1 lb	5/9 & 5/24/11	2.3 ± 2.9	CDE
Dimilin 2L	12 oz	5/24/11	3.5 ± 3.0	ABCD
diflubenzuron 2L (generic)	12 oz	5/24/11	5.2 ± 3.3	AB
Lorsban	4 pt	5/24/11	2.0 ± 1.7	CDE
Intrepid 2F[3]	16 oz	5/13/11	2.5 ± 2.0	BCDE
Intrepid 2F[3]	16 oz	5/24/11	2.0 ± 1.5	CDE
Intrepid 2F[3]	16 oz	5/26/11	2.3 ± 1.8	CDE
Delegate WG[3]	4.5 oz	5/24/11	0.5 ± 0.5	E
Delegate WG[3]	7.0 oz	5/24/11	0.3 ± 0.5	E
Altacor[2]	4.0 oz	5/13/11	0.2 ± 0.4	E
Altacor[2]	4.0 oz	5/24/11	0.2 ± 0.4	E
Altacor[2]	4.0 oz	5/26/11	0.3 ± 0.5*	E
Assail 70WP + Lamda-Cy EC	4.1 oz + 2.56 oz	5/24/11	0.8 ± 0.8	DE
Assail 70WP + Lamda-Cy EC	2.3 oz + 5.12 oz	5/24/11	0.5 ± 0.5	E
Belt SC[2]	4 oz	5/24/11	0.3 ± 0.8	E

•Means followed by the same letter do not differ significantly at *P*=0.05 by Student's t-test

[1] LI-700 added @ 0.5% v/v

[2] Dyne-Amic added @ 0.25%% v/v

[3] Induce added @ 0.25% v/v

Peach Twig Borer

Mean (±SD) peach twig borer shoot strikes per tree, Sutter, 2010

Treatment	Chemical	Rate	Date	DD	Shoot strikes/tree Mean ± SD[1]	
untreated					10.4 ± 2.6	A
Belt[2]	flubendiamide	4.0 oz	5/28	376	3.0 ± 2.4	EFG
Tourismo[2]	flubendiamide, buprofezine	10 oz	5/28	376	3.8 ± 1.5	DEFG
Tourismo[2]	flubendiamide, buprofezine	14 oz	5/28	376	2.5 ± 1.6	EFG
Intrepid 2F[3]	methoxyfenozide	16 oz	5/12	211	8.1 ± 3.8	B
Intrepid 2F[3]	methoxyfenozide	16 oz	5/28	376	8.7 ± 5.1	AB
Intrepid 2F[3]	methoxyfenozide	16 oz	6/4	507	6.8 ± 4.3	BCD
Delegate[3]	spinetoram	6.4 oz	5/12	211	1.5 ± 1.4	G
Delegate[3]	spinetoram	6.4 oz	5/28	376	1.7 ± 2.3	FG
Delegate[3]	spinetoram	7 oz	6/4	507	1.2 ± 1.0	G
Altacor 35WG[3]	chlornitraniliprole	4.0 oz	5/12	211	2.0 ± 1.1	FG
Altacor 35WG[3]	chlornitraniliprole	4.0 oz	5/28	376	1.7 ± 1.9	FG
Altacor 35WG[3]	chlornitraniliprole	4.0 oz	6/4	507	1.3 ± 1.4	G
Proclaim	emamectin benzoate	4.0 oz	5/28	376	3.7 ± 2.6	EFG
Assail 30SG[2]	acetamiprid	6.4 oz	5/28	376	2.7 ± 2.8	EFG
Lambda-Cy 1EC[2]	lamda-cyhalothrin	5.0 oz	5/28	376	4.7 ± 3.1	CDEF
Brigade 10 WP	bifenthrin	0.5 lb	5/28	376	1.0 ± 1.3	G
Bifenture 10DF[2]	bifenthrin, abamectin	16 oz	5/28	376	1.7 ± 1.5	FG

[1] Means followed by the same letter do not differ significantly at *P*=0.05 by Student's t-test

[2] Dyne-Amic added @ 0.25%% v/v

[3] Induce added @ 1.0% v/v

Spider Mites

Pacific Spider Mite
Tetranychus pacificus

Twospotted Spider Mite
Tetranychus urticae

Spider Mites

Monitoring

Webspinning mites can be sampled by counting number of mites per leaf or by a presence/absence sample

If counting - select 10 leaves from five trees and determine number per leaf; sample leaves randomly from all 4 sides and the tree interior

Calculate average number of mites per leaf

Rule of thumb treatment threshold is 4 mites per leaf

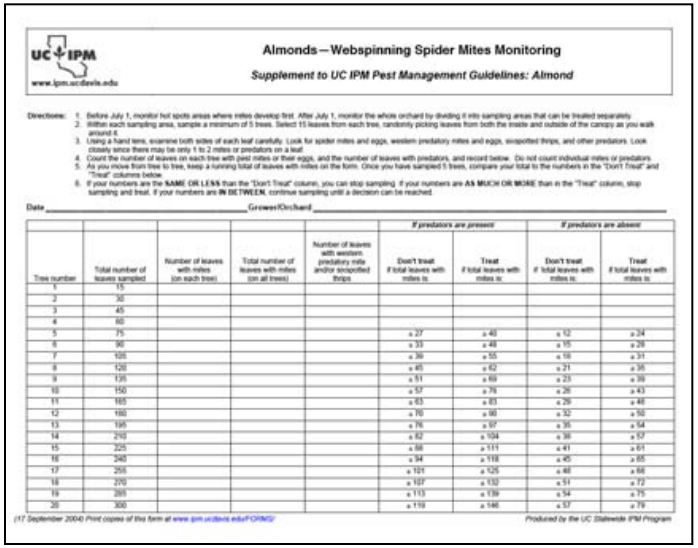
Spider Mites

Monitoring

If using presence/absence - select 15 leaves from five trees and determine number per leaf; sample leaves randomly from all 4 compass points and the tree interior

Record number of leaves with mites (not number of mites per leaf)

Rule of thumb treatment threshold is 40% infested leaves



UC IPM
www.ipm.ucdavis.edu

Almonds—Webspinning Spider Mites Monitoring

Supplement to UC IPM Pest Management Guidelines: Almond

Directions:
1. Before July 1, monitor hot spots areas where mites develop first. After July 1, monitor the whole orchard by dividing it into sampling areas that can be treated separately.
2. Within each sampling area, sample a minimum of 5 trees. Select 15 leaves from each tree, randomly picking leaves from both the inside and outside of the canopy as you walk around it.
3. Using a hand lens, examine both sides of each leaf carefully. Look for spider mites and eggs, western predatory mites and eggs, sinspotted thrips, and other predators. Look closely since there may be only 1 to 2 mites or predators on a leaf.
4. Count the number of leaves on each tree with pest mites or their eggs, and the number of leaves with predators, and record below. Do not count individual mites or predators.
5. As you move from tree to tree, keep a running total of leaves with mites on the form. Once you have sampled 5 trees, compare your total to the numbers in the "Don't Treat" and "Treat" columns below.
6. If your numbers are the **SAME OR LESS** than the "Don't Treat" column, you can stop sampling. If your numbers are **AS MUCH OR MORE** than in the "Treat" column, stop sampling and treat. If your numbers are **IN BETWEEN**, continue sampling until a decision can be reached.

Date _____ Grower/Orchard _____

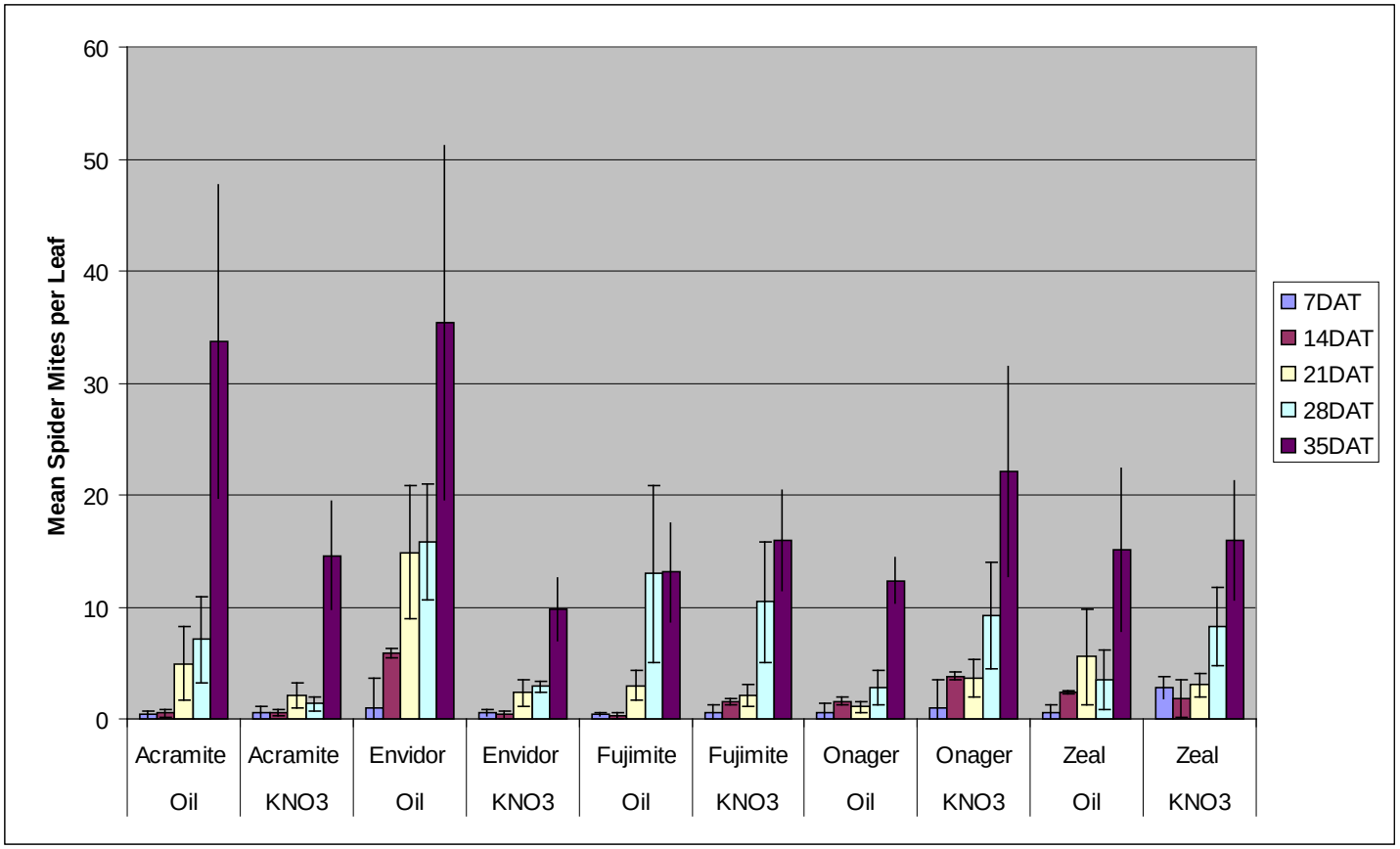
Tree number	Total number of leaves sampled	Number of leaves with mites (on each tree)	Total number of leaves with mites (on all trees)	Number of leaves with western predatory mite and/or sinspotted thrips	*If predators are present*		*If predators are absent*	
					Don't treat if total leaves with mites is:	Treat if total leaves with mites is:	Don't treat if total leaves with mites is:	Treat if total leaves with mites is:
1	15							
2	30							
3	45							
4	60							
5	75				≤ 27	≥ 40	≤ 12	≥ 24
6	90				≤ 33	≥ 48	≤ 15	≥ 28
7	105				≤ 39	≥ 55	≤ 18	≥ 31
8	120				≤ 45	≥ 62	≤ 21	≥ 35
9	135				≤ 51	≥ 69	≤ 23	≥ 39
10	150				≤ 57	≥ 76	≤ 26	≥ 43
11	165				≤ 63	≥ 83	≤ 29	≥ 46
12	180				≤ 70	≥ 90	≤ 32	≥ 50
13	195				≤ 76	≥ 97	≤ 35	≥ 54
14	210				≤ 82	≥ 104	≤ 38	≥ 57
15	225				≤ 88	≥ 111	≤ 41	≥ 61
16	240				≤ 94	≥ 118	≤ 45	≥ 65
17	255				≤ 101	≥ 125	≤ 48	≥ 68
18	270				≤ 107	≥ 132	≤ 51	≥ 72
19	285				≤ 113	≥ 139	≤ 54	≥ 75
20	300				≤ 119	≥ 146	≤ 57	≥ 79

(17 September 2004) Print copies of this form at www.ipm.ucdavis.edu/FORMS/ Produced by the UC Statewide IPM Program

Spider Mites

Miticides

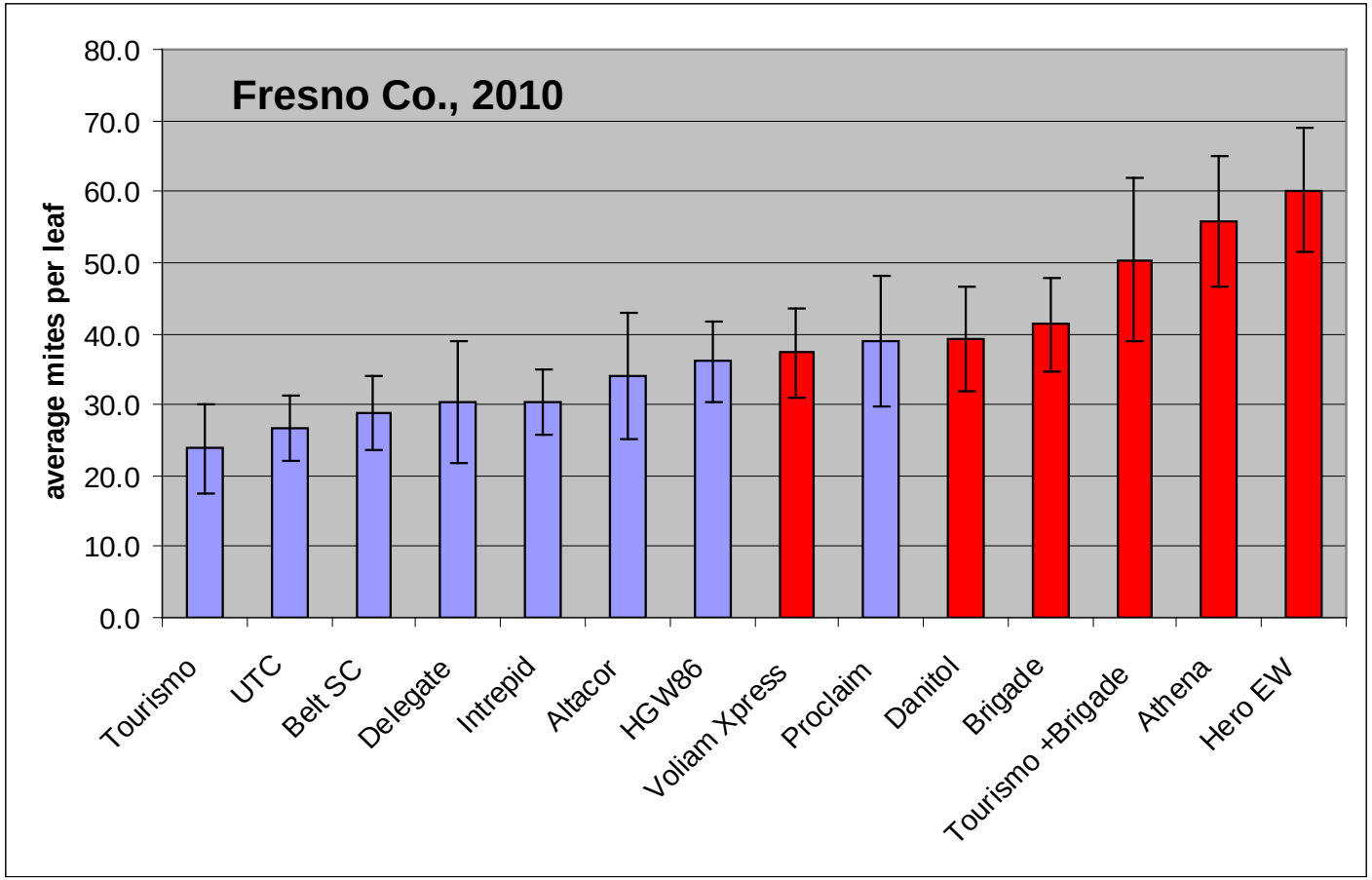
Mean (±SD) spider mites per leaf, Kern Co., 2011



D. Haviland, UCCE

Nontarget effects

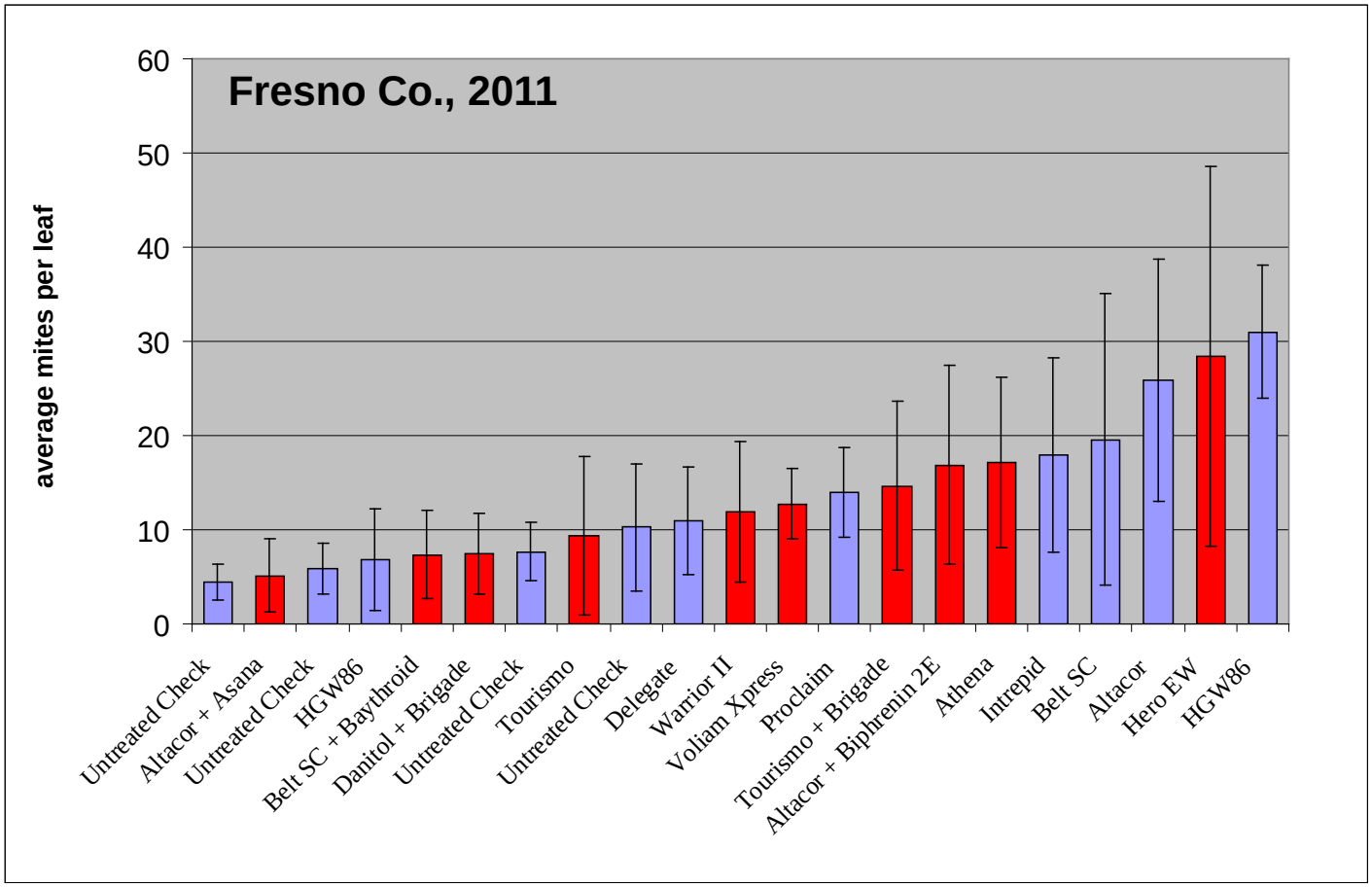
Effects of NOW treatments on spider mites ~ 4 weeks after application



D. Haviland, UCCE

Nontarget effects

Effects of NOW treatments on spider mites ~ 4 weeks after application



D. Haviland, UCCE

Insect and Mite Management Update

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Summary:

- Use cultural controls for NOW
- Target 'key' pests with less disruptive products that have lower environmental and nontarget concerns
- New products can be used with NOW mating disruption to further reduce damage
- Consider applying 'May' sprays with less disruptive products as a replacement for dormant sprays for PTB
- Pyrethroids are 'cheap', but consider the additional costs of miticides and environmental mitigation

Insect and Mite Management Update

What's New in Almond Weed Management?

Brad Hanson, Cooperative Extension Weed Specialist

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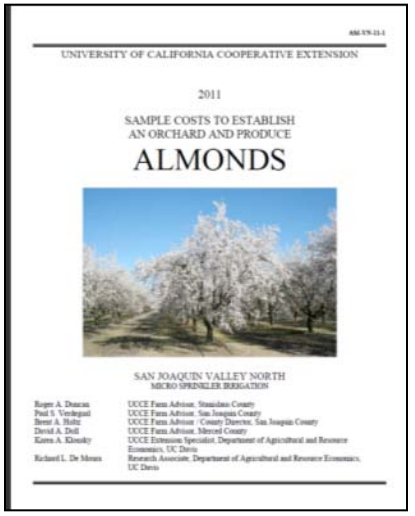
What Do We Spend on Weed Control?


UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

2011

SAMPLE COSTS TO ESTABLISH AN ORCHARD AND PRODUCE

ALMONDS

SAN JOAQUIN VALLEY NORTH
MICRO SPRINKLER IRRIGATION

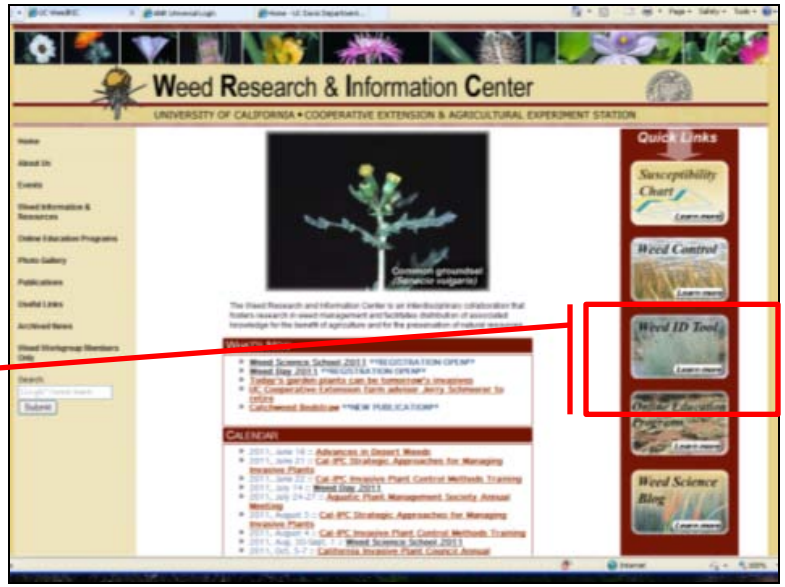
- **2011 cost studies – Duncan et al.**
  - Annual costs for weed mgt
    - $41 – Mowing middles 6x
    - $19 – spring strip spray (Rely)
    - $27 – preharvest (Goal / Roundup)
    - $101 – Winter dormant applic. (Roundup / Matrix)
    - ~$188 per acre / per year
- **Is that typical?**
  - Not a bad estimate but probably a bit low for some common programs

Effective Weed Control in Almonds

- **Correctly identify the weed problem(s)**
- **Select registered herbicide(s) with activity on your weed spectrum**
- **Properly apply the material**
  - Calibrated equipment, good timing & growth stage

Weed Research and Information Center
http://wric.ucdavis.edu

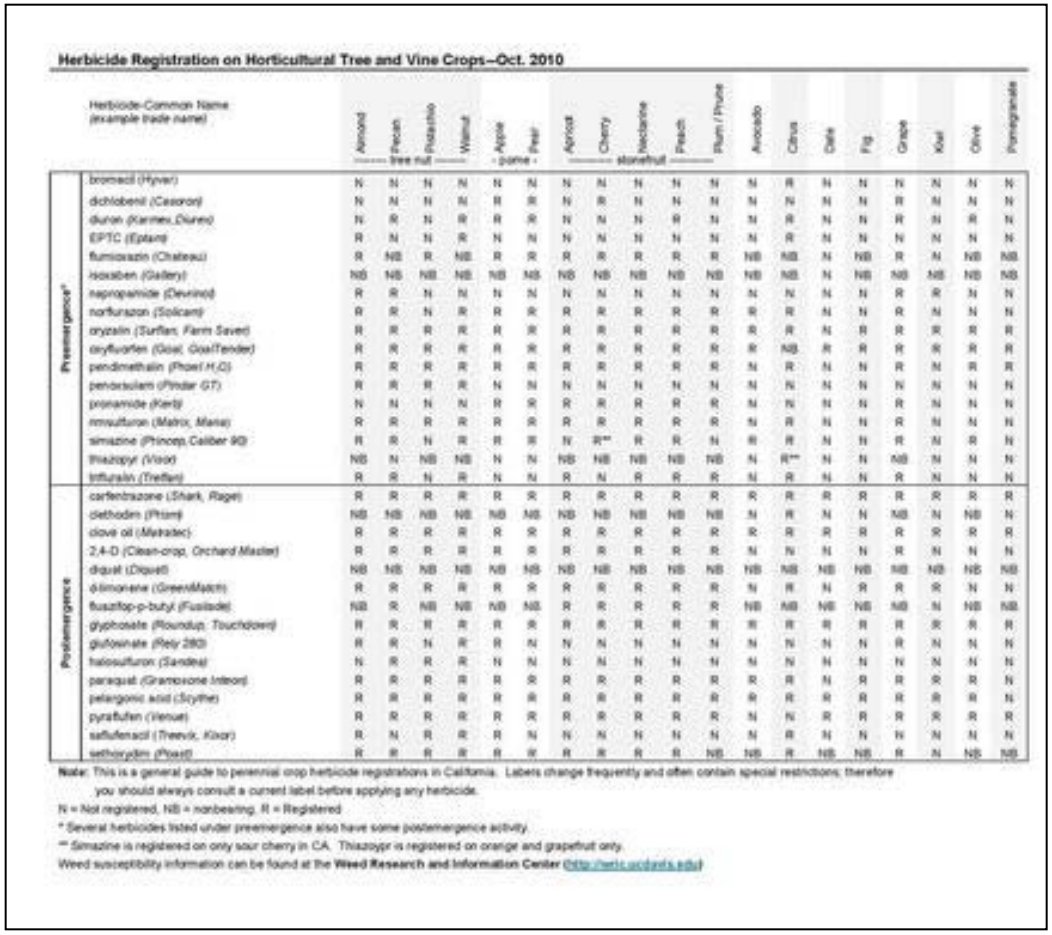
Online weed ID tool
and other good weed info



Factors in Herbicide Choice

- **Availability (registration)**
- **Weed spectrum**
- **PRE vs POST activity**
- **Incorporation by rainfall or irrigation**
- **Resistance management**
  - Mode of action, tank mix partners, rotation
- **Reentry and harvest intervals**
- **Toxicity and safety**
- **Cost / benefit**

Tree and Vine Crops Herbicide Registration Chart



Herbicide Registration on Horticultural Tree and Vine Crops--Oct. 2010

	Herbicide-Common Name (example trade name)	Almond	Pecan	Pistachio	Walnut	Apple	Pear	Apricot	Cherry	Nectarine	Peach	Plum / Prune	Avocado	Citrus	Date	Fig	Grape	Kiwi	Olive	Pomegranate
		tree nut				pome		stonefruit												
Preemergence*	bromacil (Hyvar)	N	N	N	N	N	N	N	N	N	N	N	N	R	N	N	N	N	N	N
	dichlobenil (Casoron)	N	N	N	N	R	R	N	R	N	N	N	N	N	N	N	R	N	N	N
	diuron (Karmex, Diuron)	N	R	N	R	R	R	N	N	N	R	N	N	R	N	N	R	N	R	N
	EPTC (Eptam)	R	N	N	R	N	N	N	N	N	N	N	N	R	N	N	N	N	N	N
	flumioxazin (Chateau)	R	NB	R	NB	R	R	R	R	R	R	R	NB	NB	N	NB	R	N	NB	NB
	isoxaben (Gallery)	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	N	NB	NB	NB	NB	NB
	napropamide (Devrinol)	R	R	N	N	N	N	N	N	N	N	N	N	N	N	N	R	R	N	N
	norflurazon (Solicam)	R	R	N	R	R	R	R	R	R	R	R	R	R	N	N	R	N	N	N
	oryzalin (Surflan, Farm Saver)	R	R	R	R	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R
	oxyfluorfen (Goal, GoalTender)	R	R	R	R	R	R	R	R	R	R	R	R	NB	R	R	R	R	R	R
	pendimethalin (Prowl H2O)	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	R	R
	penoxsulam (Pindar GT)	R	R	R	R	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	pronamide (Kerb)	N	N	N	N	R	R	R	R	R	R	R	N	N	N	N	R	N	N	N
	rimsulfuron (Matrix, Mana)	R	R	R	R	R	R	R	R	R	R	R	N	R	N	N	R	N	N	N
	simazine (Princep,Caliber 90)	R	R	N	R	R	R	N	R**	R	R	N	R	R	N	N	R	N	R	N
	thiazopyr (Visor)	NB	N	NB	NB	N	N	NB	NB	NB	NB	NB	N	R**	N	N	NB	N	N	N
	trifluralin (Treflan)	R	R	N	R	N	N	R	N	R	R	R	N	R	N	N	R	N	N	N
Postemergence	carfentrazone (Shark, Rage)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	clethodim (Prism)	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	N	R	N	N	NB	N	NB	N
	clove oil (Matratec)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	2,4-D (Clean-crop, Orchard Master)	R	R	R	R	R	R	R	R	R	R	R	N	N	N	N	R	N	N	N
	diquat (Diquat)	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB
	d-limonene (GreenMatch)	R	R	R	R	R	R	R	R	R	R	R	N	R	N	R	R	R	N	N
	fluazifop-p-butyl (Fusilade)	NB	R	NB	NB	NB	NB	R	R	R	R	R	NB	NB	NB	NB	NB	N	NB	NB
	glyphosate (Roundup, Touchdown)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	glufosinate (Rely 280)	R	R	N	R	R	N	N	N	N	N	N	N	N	N	R	R	N	N	N
	halosulfuron (Sandea)	N	R	R	R	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	paraquat (Gramoxone Inteon)	R	R	R	R	R	R	R	R	R	R	R	R	R	N	R	R	R	R	N
	pelargonic acid (Scythe)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	N
	pyraflufen (Venue)	R	R	R	R	R	R	R	R	R	R	R	N	N	R	R	R	R	R	R
	saflufenacil (Treevix, Kixor)	R	N	R	R	R	N	N	N	N	N	N	N	R	N	N	N	N	N	N
	sethoxydim (Poast)	R	R	R	R	R	R	R	R	R	R	NB	NB	R	NB	NB	R	N	NB	NB

Note: This is a general guide to perennial crop herbicide registrations in California. Labels change frequently and often contain special restrictions; therefore you should always consult a current label before applying any herbicide.

N = Not registered, NB = nonbearing, R = Registered

* Several herbicides listed under preemergence also have some postemergence activity.

** Simazine is registered on only sour cherry in CA. Thiazopyr is registered on orange and grapefruit only.

Weed susceptibility information can be found at the **Weed Research and Information Center** (http://wric.ucdavis.edu)

UC Davis Weed Research and Information Center
http://wric.ucdavis.edu/

http://ucanr.org/blogs/UCDWeedScience/

Herbicides Registered in Almond - PRE

Devrinol
EPTC
Solicam
Treflan
Visor*

Princep
Surflan
Prowl H2O
Chateau
Goal / GoalTender

*Gallery** / Trellis
Matrix
Pindar GT
Alion

** Registered for non-bearing only*

Herbicides Registered in Almond - POST

Chateau
Goal
Matrix
Pindar GT

*Prism**
*Fusilade**
Select
Poast
Diquat*
Scythe
2,4-D
Shark

Glyphosate
Gramoxone
Rely 280
Venue
Treevix

** Registered for non-bearing only*

CA Almond Herbicide Use

	Top 10 active ingredients	2009 treated acreage
1	glyphosate	1,300,394
2	oxyfluorfen (Goal, Goaltender)	723,524
3	glufosinate (Rely)	271,135
4	paraquat (Gramoxone Inteon)	250,156
5	pendimethalin (Prowl)	167,689
6	2,4-D	152,455
7	oryzalin (Surflan, etc)	99,220
8	simazine (Princep, etc)	92,220
9	flumioxazin (Chateau)	90,718
10	carfentrazone (Shark)	68,360
11	rimsulfuron (Matrix)	52,577

* strip treatments!

740,000 A bearing almond (2010)

Difficult Weed Problems – Old and New

- **Glyphosate-resistant weeds**
  - Horseweed
  - Hairy fleabane
    - Glyphosate and paraquat
  - Ryegrass (2 species)
  - Junglerice

Difficult Weed Problems – Old and New

- **Weed shifts in some areas**
  - Cutleaf evening primrose
  - Tall willowherb
  - Sharp-point fluvellin
  - Johnsongrass
  - Bristly mallow
  - Witchgrass
  - Others?

Selecting Herbicides

- **Properly identify the problem(s)**
- **Develop a management program specific to your orchard**
  - Manage YOUR weeds
- **Consider:**
  - Efficacy, short- and longer-term economics, environmental quality and regs
  - Fit into other weed management operations

Resistance Management

Residual vs Contact Programs

Consider the Cost

- **Many residual herbicides cost more than burndown herbicides - but do they?**
- **Consider the full cost of repeated burndown applications?**
  - active + adjuvants + machine costs + time
  - More mowing or tillage?
  - Timely weed control (wet winter/spring)
- **Consider weed costs over several years**

Each trip (mow or spray) costs about $7/A for labor and machine costs

Increasing Herbicide Efficacy

- **Use the right herbicide(s) for the job**
- **Read and follow the label**
- **Treat the weeds at the right time**
- **Calibrate your sprayer and properly train the applicators**
- **Scout fields and follow up on escapes or other problems**

Put the Herbicide On-target

- **Residual herbicides:**
  - Blow berms before application
  - Treat ahead of rain or irrigations
- **POST materials:**
  - Large weeds are hard to control
  - Stressed weeds are hard to control
  - Use appropriate surfactants for penetration, retention, or water conditioning

Middles and edges can allow weed problems to continue and grow!

Think about your OC nozzles!

Not all Orchard Problems Are From Herbicides, But Some Are!

Request: Resistant Weed Survey

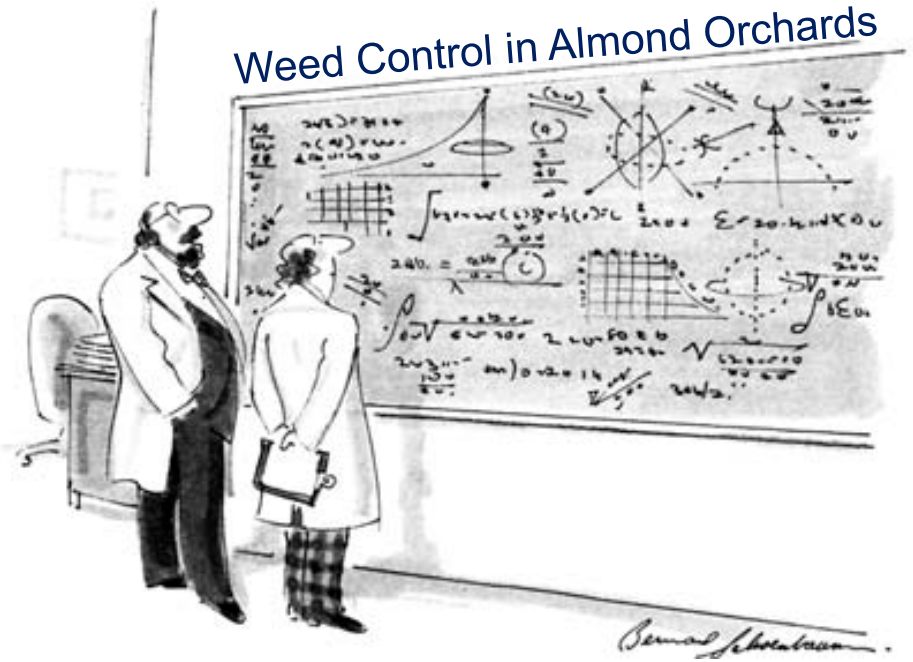
- **We are conducting a survey (questionnaire) about grower and PCA experiences with herbicide resistant weeds**
- **Please take the survey online at: http://ucanr.org/hrwsurvey**
  - Handouts with the URL available
  - Should only take about 10 minutes
- **Enter a drawing for Weed Books and Production Guides (in February)**

Burndown Herbicide Comparison

Chemical name	*Glyphosate*	*Glufosinate*	*Paraquat*
Trade name(s)	Roundup, Durango, Honcho, etc	Rely, Rely 200, Rely 280	Gramoxone, Gramoxone Inteon
Mode of action	Inhibits EPSP synthase (EPSPS) enzyme	Inhibits glutamine synthetase enzyme	Photosystem I inhibitor
Selectivity	Non-selective	Non-selective	Non-selective
Soil activity	Essentially none	Essentially none	None
Translocation	Very good	Limited	Very limited
Coverage needed	Less critical	Critical – especially on larger weeds	Critical – especially on larger weeds
Broadleaf weed control	Broad spectrum. Good control of small to medium plants but can vary with large weeds.	Broad spectrum. Good control of small weeds, less effective on large weeds or dense stands due to coverage.	Broad spectrum. Good control of small weeds, less effective on large weeds or dense stands due to coverage.
Grass weed control	Broad spectrum. Usually good control of vigorously growing grasses	Broad spectrum. Control can vary by size - seedling grasses often controlled, small established grasses may be burned down but regrow, some success with medium-sized grasses nearing maturity	Broad spectrum activity but control varies. Seedling grasses often controlled, but established grasses usually burned down but regrow
Perennial weed control	Good – can vary depending on plant size and time of year	Poor – burns tops; however plants often regrow from roots/rhizomes	Poor – burns tops; however plants often regrow from roots/rhizomes
Resistance reported	Yes, in California – ryegrass, horseweed, hairy fleabane, others suspected. 19 species worldwide.	Not in California. Ryegrass in Oregon, goosegrass in Malaysia.	Yes, in California – hairy fleabane, horseweed, 3 other in USA, 25 species worldwide

http://ucanr.org/blogs/UCDWeedScience/

Questions?



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UC Davis Weed Research and Information Center
http://wric.ucdavis.edu/
http://ucanr.org/blogs/UCDWeedScience/

Resistant Weed Survey
http://ucanr.org/hrwsurvey

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