Walnut Scale & Walnut Husk Fly

Emily J. Symmes
Area Integrated Pest Management Advisor, Sacramento Valley
University of California Cooperative Extension & Statewide IPM Program
ejsymmes@ucanr.edu
530-538-7201
@SacValleyIPM

Sac-Solano-Yolo Walnut Day
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Life Cycle and Management of Walnut Scale

Emily J. Symmes

Area Integrated Pest Management Advisor, Sacramento Valley

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Walnut Scale Basic Biology

Eggs (under female cover)

Crawlers (mobile)

Nymphs (immobile)

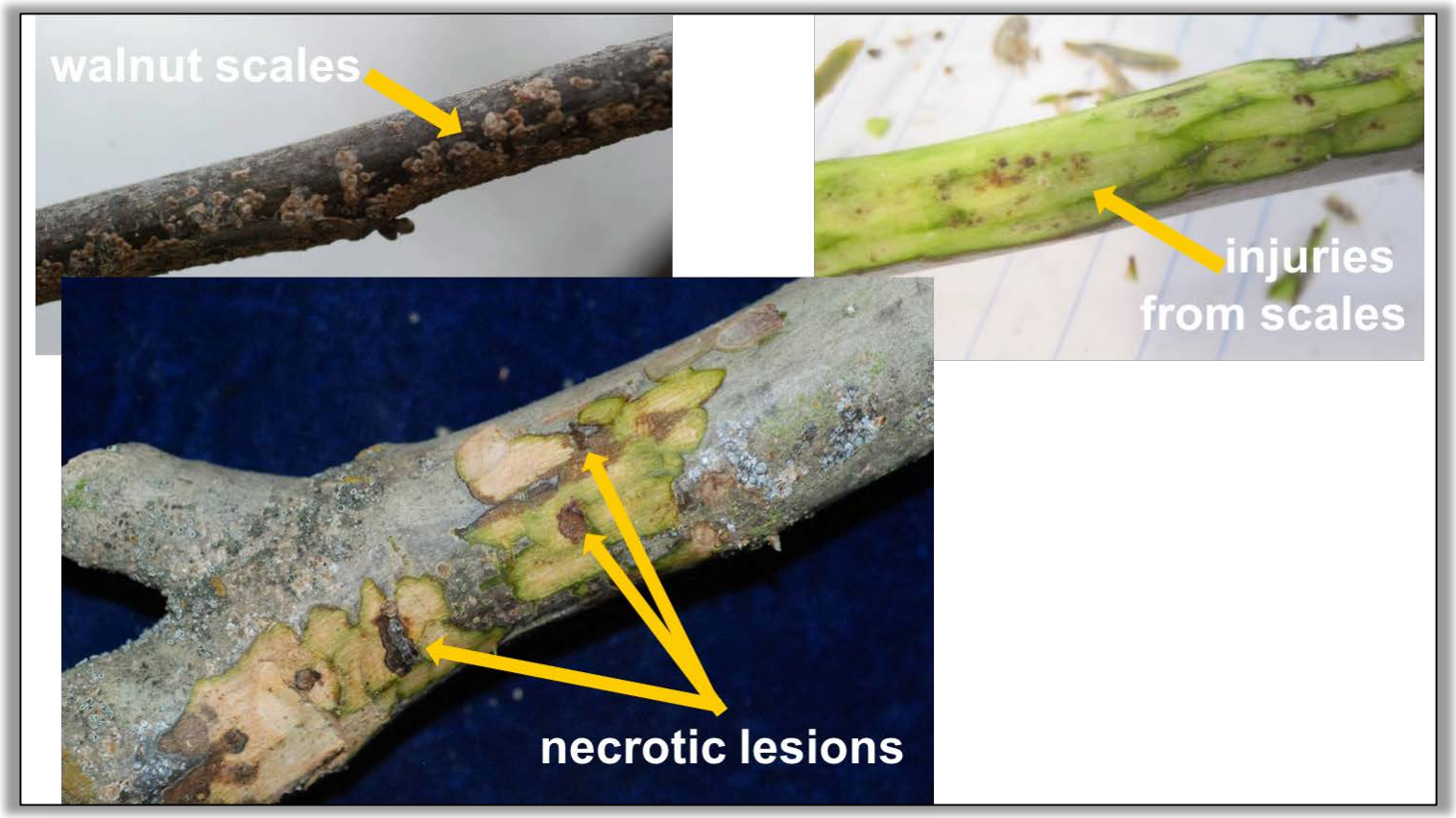
Adult females

Adult males

Impact of Walnut Scale

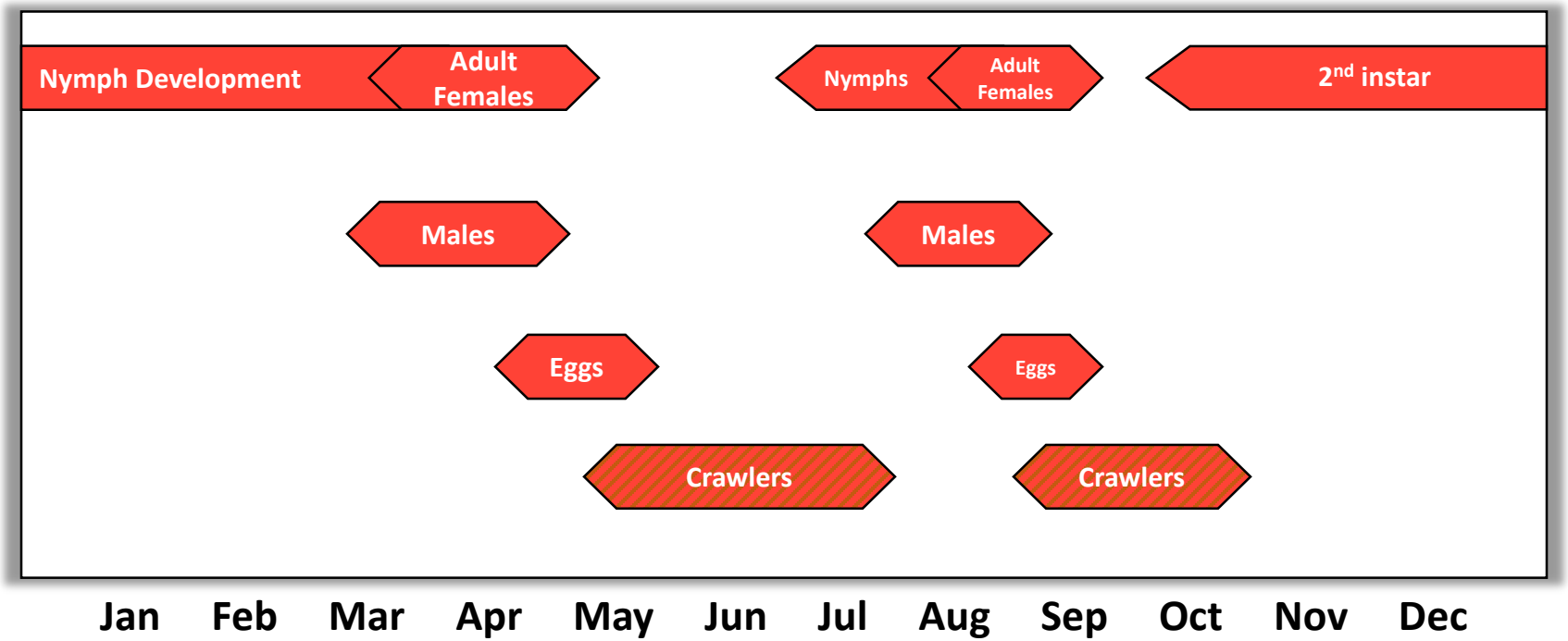
- Suck plant juices
- Infested trees can appear water stressed
- Heavy populations may cause dieback of inside fruiting wood on lateral bearing cultivars, cracking of bark, reduced terminal growth & vigor leading to smaller nuts & poor kernel quality
- Economic damage rare unless populations very heavy, but…
- ***Feeding can provide entry point for pathogens
  - Ex: Bot-walnut scale association

Impact of Walnut Scale



Association with *Botryosphaeria*

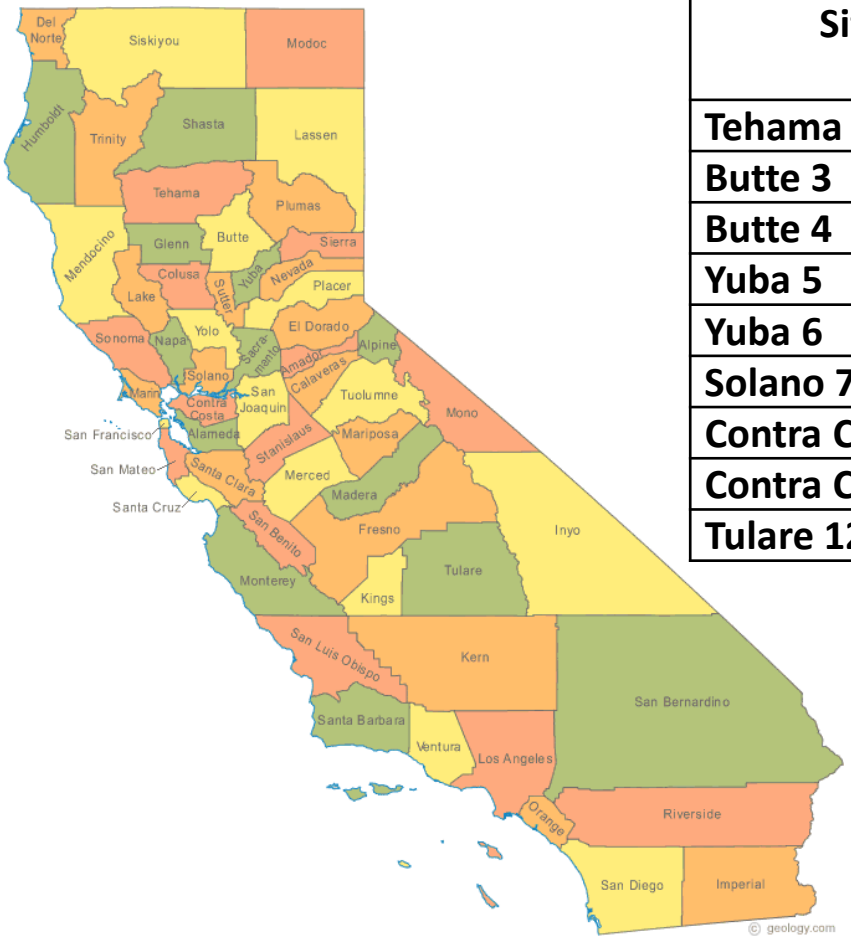
Walnut Scale Seasonal Cycle*



- Two generations/year
- Overwinter as 2nd instar nymphs
- Resume development late winter – spring
- 1st generation crawler emergence late April – early May
- 2nd generation crawlers late summer – fall

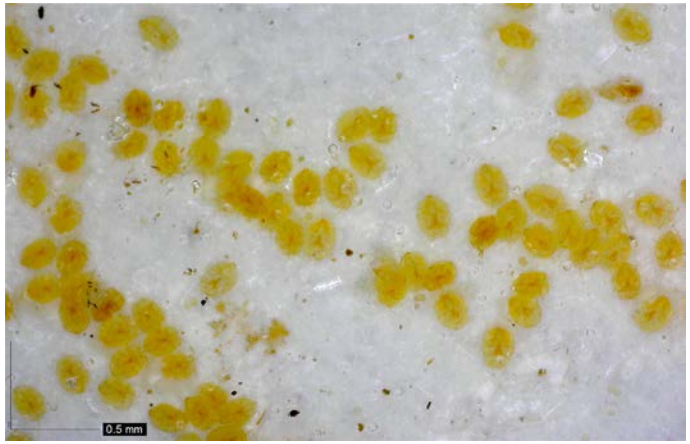
*Phenology model pieced together from limited studies and are approximate timings only.

2015 Phenology Study



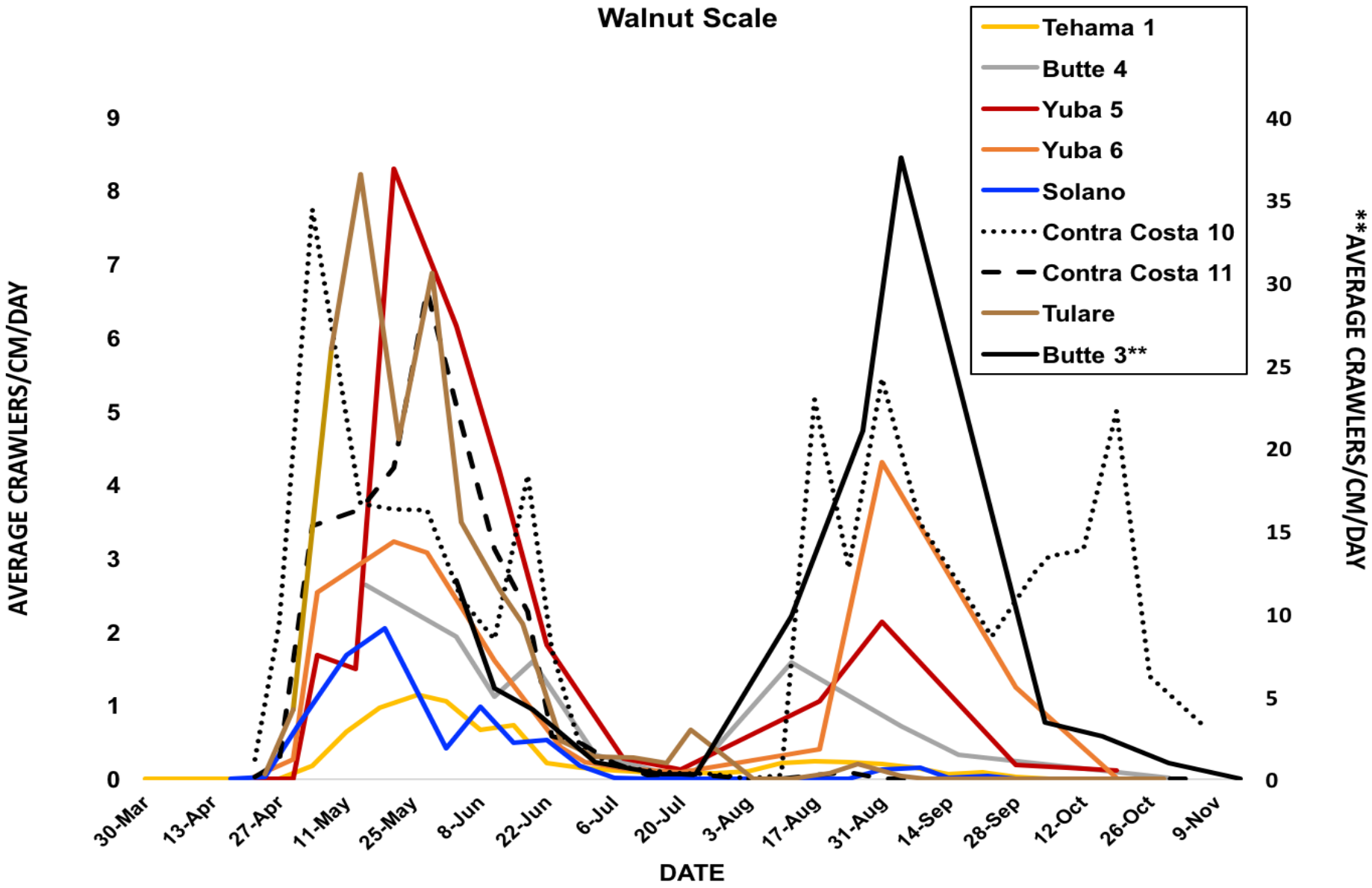
Site	Cultivar	Number of replicate tapes (total trees)	Parasitoid activity detected
Tehama 1	Howard	4 (4)	Yes
Butte 3	Chandler	10 (5)	Yes
Butte 4	Howard	10 (5)	Yes
Yuba 5	Vina	12 (6)	Yes
Yuba 6	Chandler	18 (6)	Yes
Solano 7	Chandler	12 (9)	Yes
Contra Costa 10	Chandler	12 (6)	Yes
Contra Costa 11	Chandler	12 (6)	Yes
Tulare 12	Chandler	10 (5)	Yes

2015 Phenology Study – Crawler Monitoring



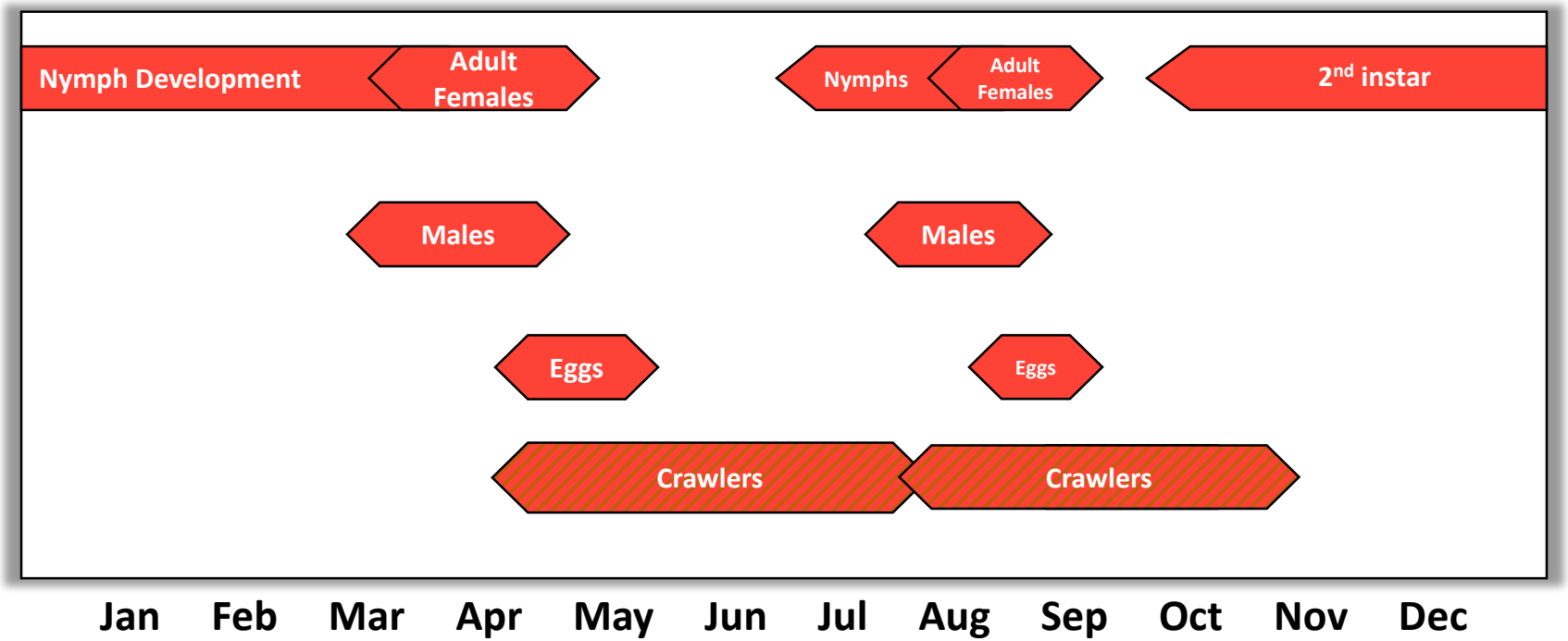
Appr. 100X magnification

2015 Phenology Study



2015 Phenology Study – General Conclusions

- 2 generations/year in all locations
- Extended crawler periods
  - Appears to be more overlap between generations than previously reported



Biological Control: Walnut Scale Parasitoids

Biological Control: Walnut Scale Predators

Twicestabbed lady beetle adult and larva

***Cybocephalus californicus* beetle**

Walnut Scale Monitoring: Dormant Period

- **Examine scaffolds, limbs, branches, and prunings for scales & evidence of parasitism**

- **Historical treatment thresholds: pests + parasitization**

  - **If high degree of parasitization observed, consider delaying treatments until after crawler emergence**

- **Current thresholds – must consider Botryosphaeria**

*****If treatments were applied previous season, confirm whether scales are still alive*****

Walnut Scale Monitoring: Dormant Period

Live walnut scale nymphs (above)
Live walnut scale adult females (below)

Dead adult female walnut scale

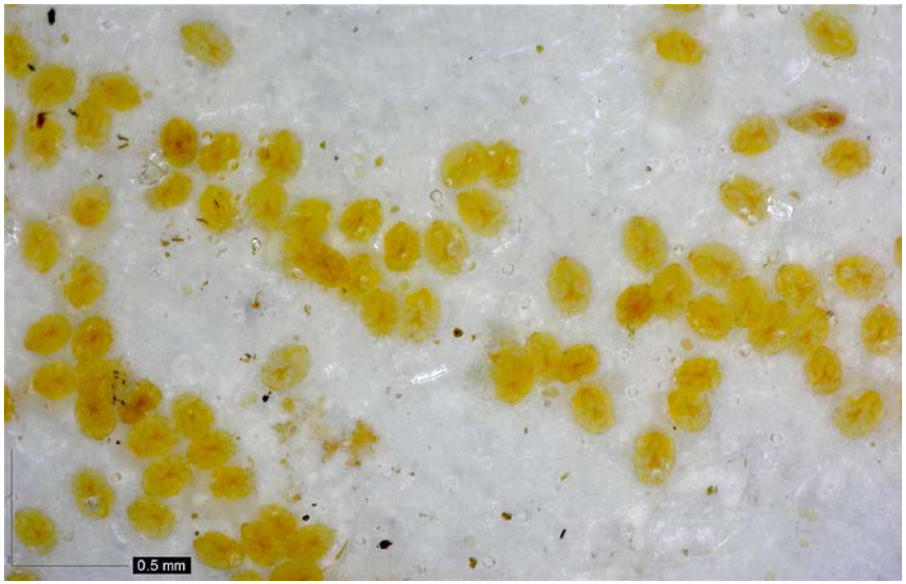
Walnut Scale Monitoring: Crawlers

Double-sided sticky tape

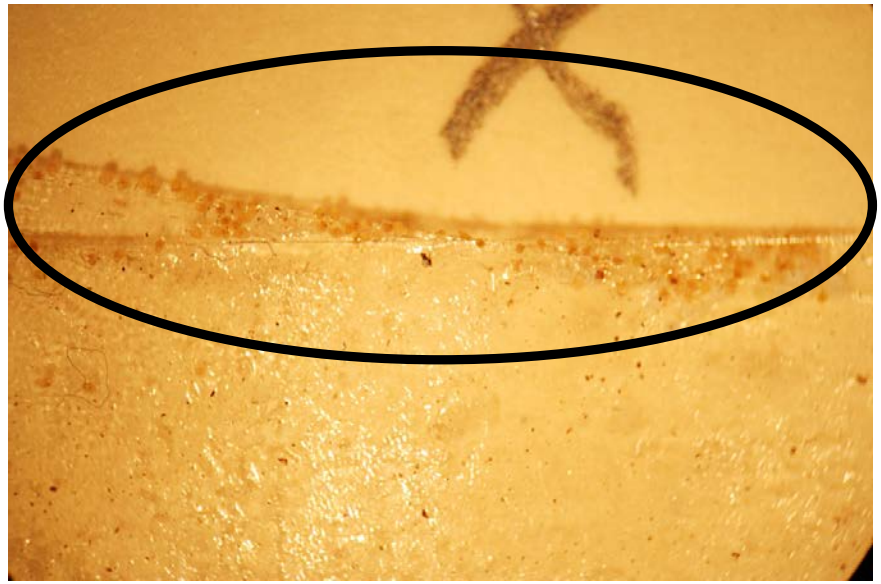
- Place tapes by mid-April
- Monitor weekly
- Aid in treatment timing
- Confirm live populations
- Assess population densities

Photos: D.M. Lightle, R.P. Buchner

Walnut Scale Monitoring: Dormant Period



Appr. 100X magnification



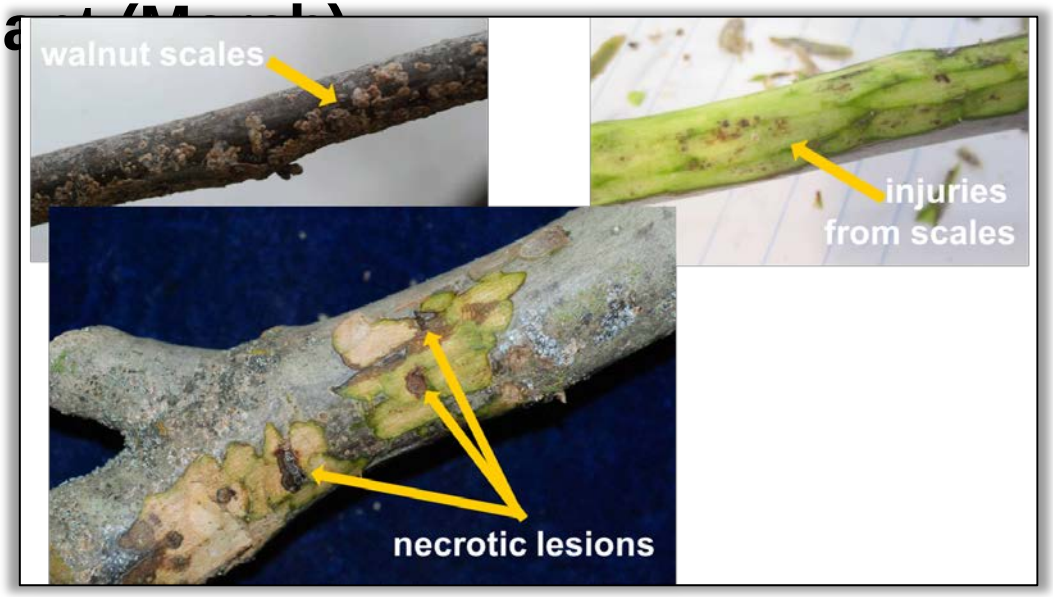
Often high densities at margins of tape (low magnification)

Photos: E. J. Symmes (L) and D. M. Lightle (R)

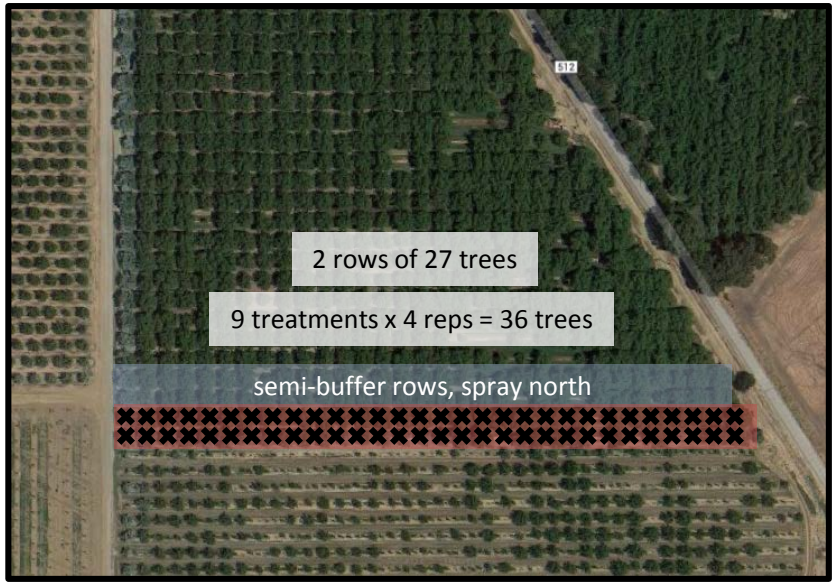
Walnut Scale Management Options & Timing

- **Pre-Bot: Biological control provided adequate suppression of low to moderate populations**

- **Bot-era: Insecticide treatment timings**
  - **Delayed-dorma**
  - **Crawler stage**



2014-2015 Insecticide Evaluations



- ‘Vina’ walnut orchard, Yuba County, CA
- Treatment timings
  - Post-delayed dormant or first generation crawler
- Each tree monitored for crawlers
  - 25-March-2014 to 2-June-2014
- During dormant season, twigs examined for number of live scales
  - 21-January-2015
- Follow-up crawler evaluations
  - 4-June-2015 and 11-June-2015

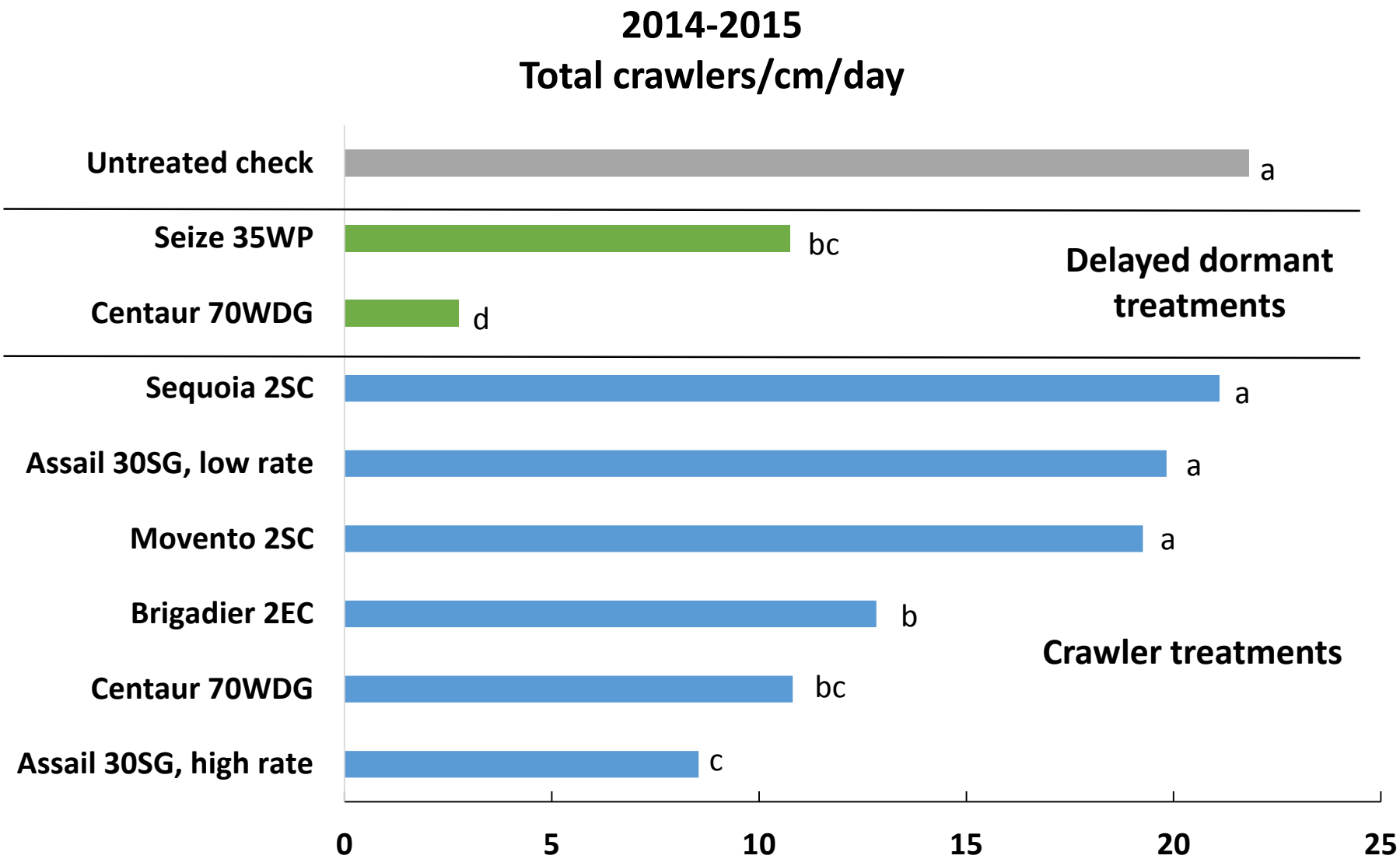
2014-2015 Insecticide Evaluations

Treatment (AI)*	Rate form/ acre	IRAC # (Mode of Action)	Application Timing
Untreated Check	--	--	--
Seize 35WP (pyriproxyfen)	5.0 oz.	7C (IGR – juvenile hormone mimic)	DD
Centaur 70WDG (buprofezin)	46.0 oz.	16 (IGR – chitin synthesis inhibitor)	DD
Sequoia 2SC (sulfoxaflor)	5.75 fl. oz.	4C (sulfoximine – nerve toxin)	C
Assail 30SG (acetamiprid)	5.3 oz.	4A (neonicotinoid – nerve toxin)	C
Assail 30SG (acetamiprid)	9.6 oz.	4A (neonicotinoid – nerve toxin)	C
Movento 2SC (spirotetramat)	9.0 fl. oz.	23 (IGR – lipid biosynthesis inhibitor)	C
Brigadier 2EC (bifentrhin + imidacloprid)	12.8 fl. oz.	3 and 4A (pyrethroid + neonicotinoid – nerve toxins)	C
Centaur 70WDG (buprofezin)	46 oz.	16 (IGR – chitin synthesis inhibitor)	C

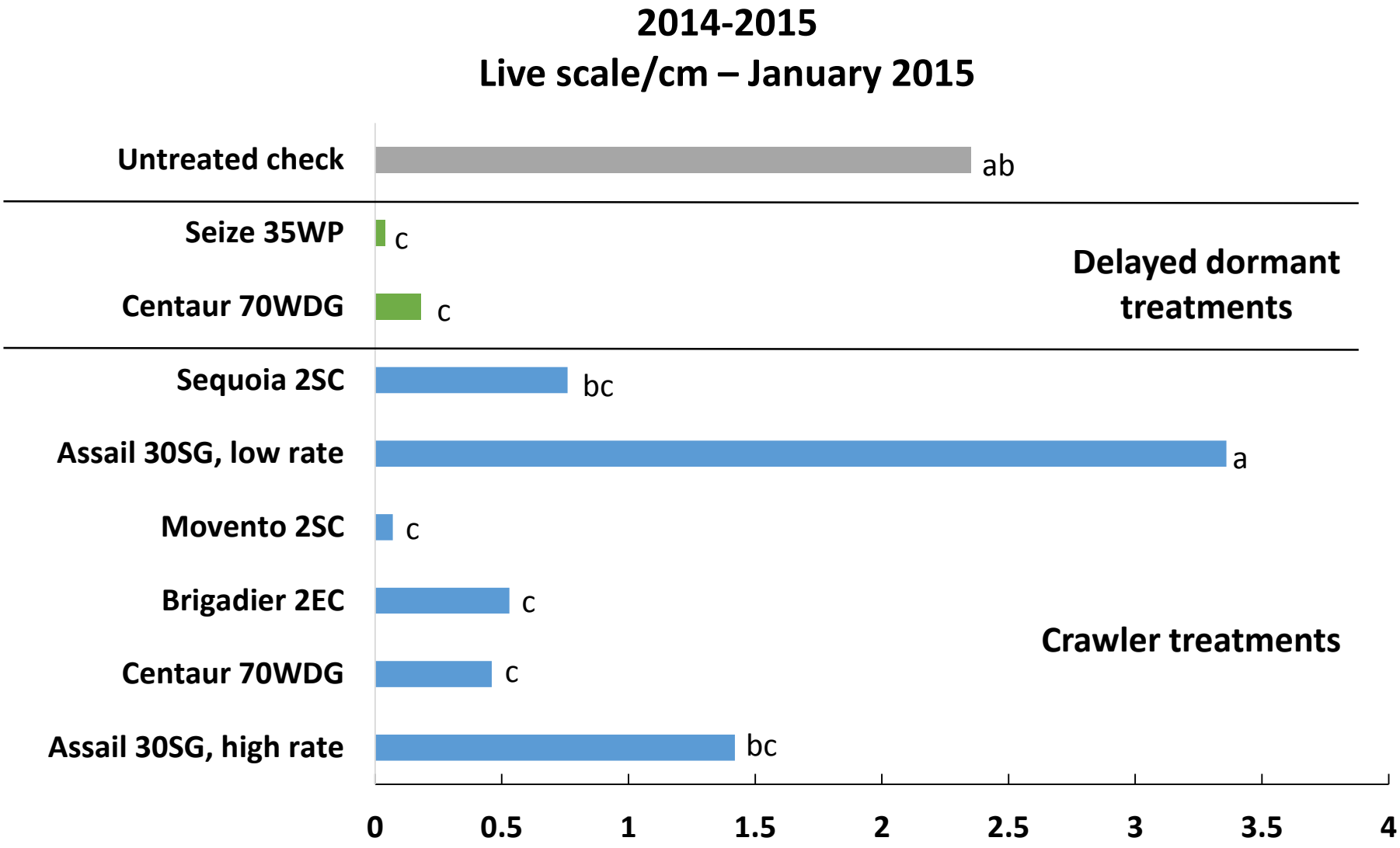
*All treatments included 0.25% v/v Latron B-1956

DD = (post) delayed-dormant (8-April-2014)
C = crawler (6-May-2014)

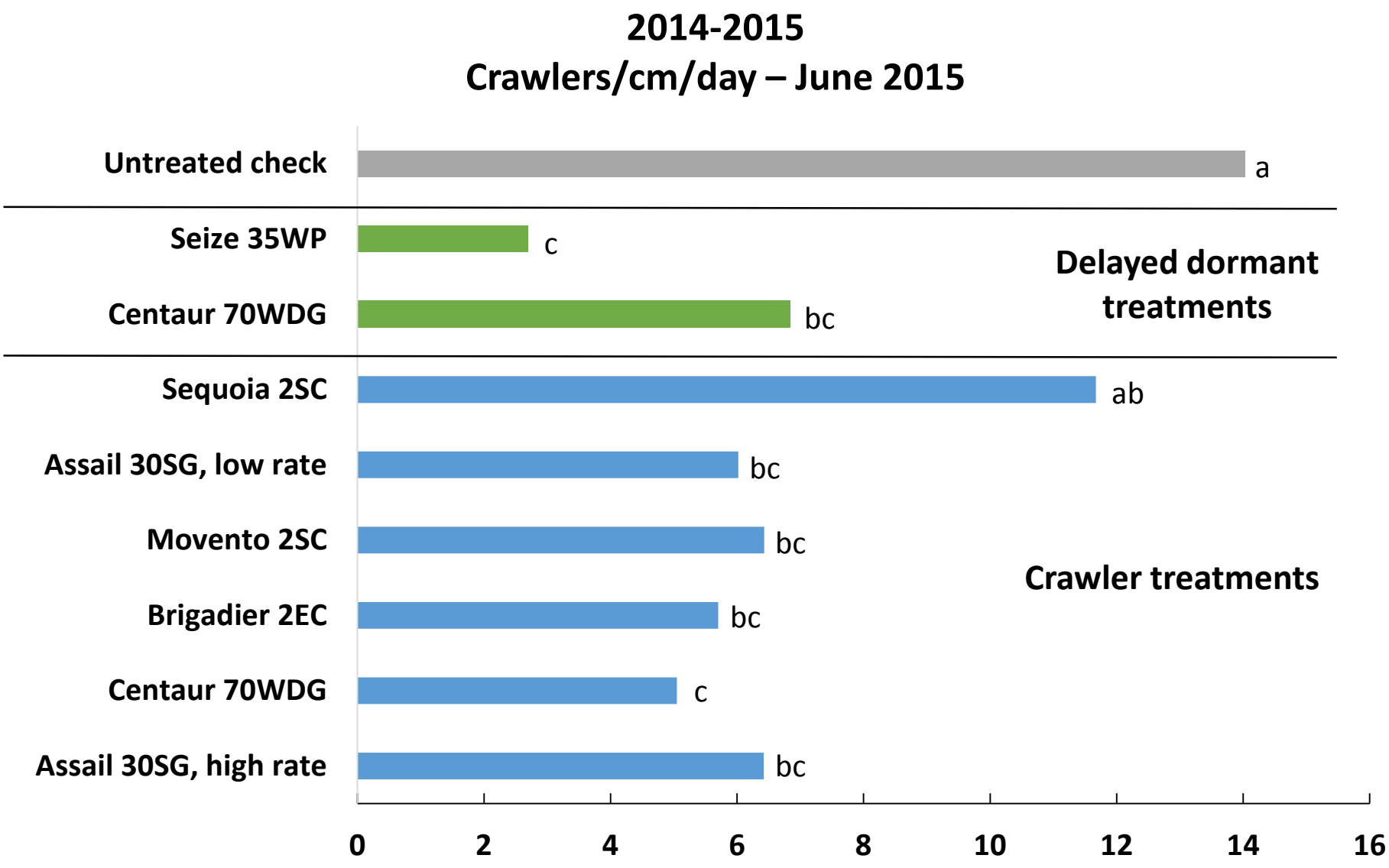
2014-2015 Insecticide Evaluations



2014-2015 Insecticide Evaluations



2014-2015 Insecticide Evaluations



2014-2015 Insecticide Evaluations

- **General Conclusions**

- **Centaur 70WDG (delayed dormant) provided best control of within-generation crawlers**

- **Centaur 70WDG (delayed dormant & crawler), Seize 35WP (delayed dormant), Movento 2SC (crawler), and Brigadier 2EC (crawler) provided best control based on OW populations**

- **All treatments except Sequoia 2SC provided significant population suppression the following spring compared to UTC**

2015-2016 Insecticide Evaluations

- **'Chandler' walnut orchard, Yuba County, CA**
- **Treatment timings**
  - **Delayed dormant and/or first generation crawlers**
- **Each tree monitored for crawlers**
  - **14-April-2015 to 25-June-2015**
- **During dormant season, twigs examined for number of live scales**
  - **January 2016**

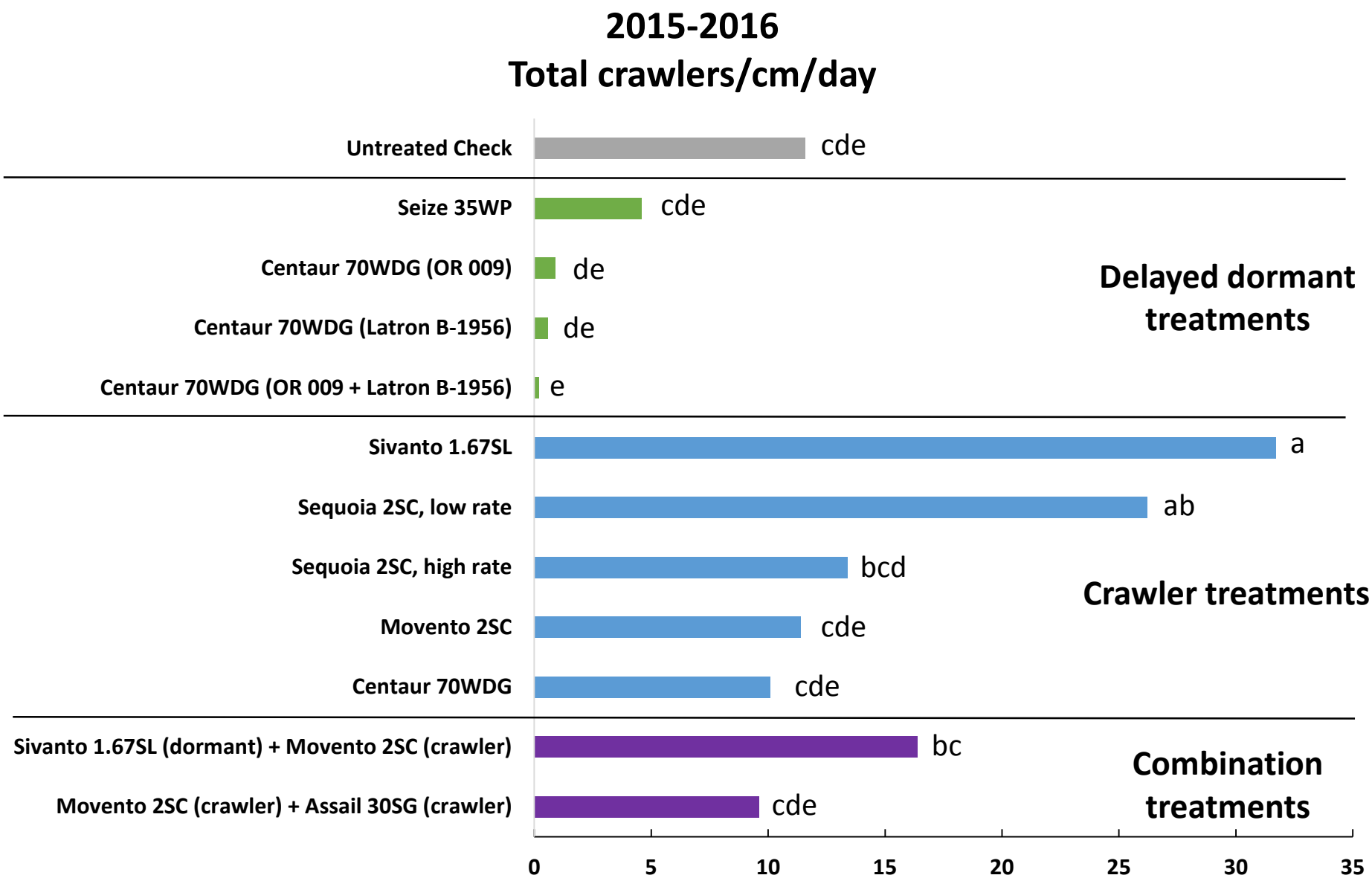
2015-2016 Insecticide Evaluations

Treatment (AI)	Rate form/ acre	Mode of Action (IRAC #)	Application Timing
Untreated Check	--		--
Seize 35WP[b] (pyriproxyfen)	5.0 oz.	7C (IGR – juvenile hormone mimic)	DD
Centaur 70WDG[b] (buprofezin)	46.0 oz.	16 (IGR – chitin synthesis inhibitor)	DD
Centaur 70WDG[c] (buprofezin)	46.0 oz.	16 (IGR – chitin synthesis inhibitor)	DD
Centaur 70WDG[cd] (buprofezin)	46.0 oz.	16 (IGR – chitin synthesis inhibitor)	DD
Sivanto 1.67SL[a] (flupyradifurone)	14.0 fl. oz.	4D (butenolide – nerve toxin)	C
Sequoia 2SC[a]	4.5 fl. oz.	4C (sulfoximine – nerve toxin)	C
Sequoia 2SC[a]	5.75 fl. oz.	4C (sulfoximine – nerve toxin)	C
Movento 2SC[a] (spirotetramat)	9.0 fl. oz.	23 (IGR – lipid biosynthesis inhibitor)	C
Centaur 70WDG[a] (buprofezin)	46 oz.	16 (IGR – chitin synthesis inhibitor)	C
Sivanto 1.67 SL[b] (flupyradifurone) Movento 2SC[a] (spirotetramat)	14.0 fl. oz. 9.0 fl. oz.	4D (butenolide – nerve toxin) 23 (IGR – lipid biosynthesis inhibitor)	DD C
Movento 2CS (spirotetramat) + Assail 30SG[a] (acetamiprid)	9.0 fl. oz. + 8.0 fl. oz.	23 (IGR – lipid biosynthesis inhibitor) 4A (neonicotinoid – nerve toxin)	C

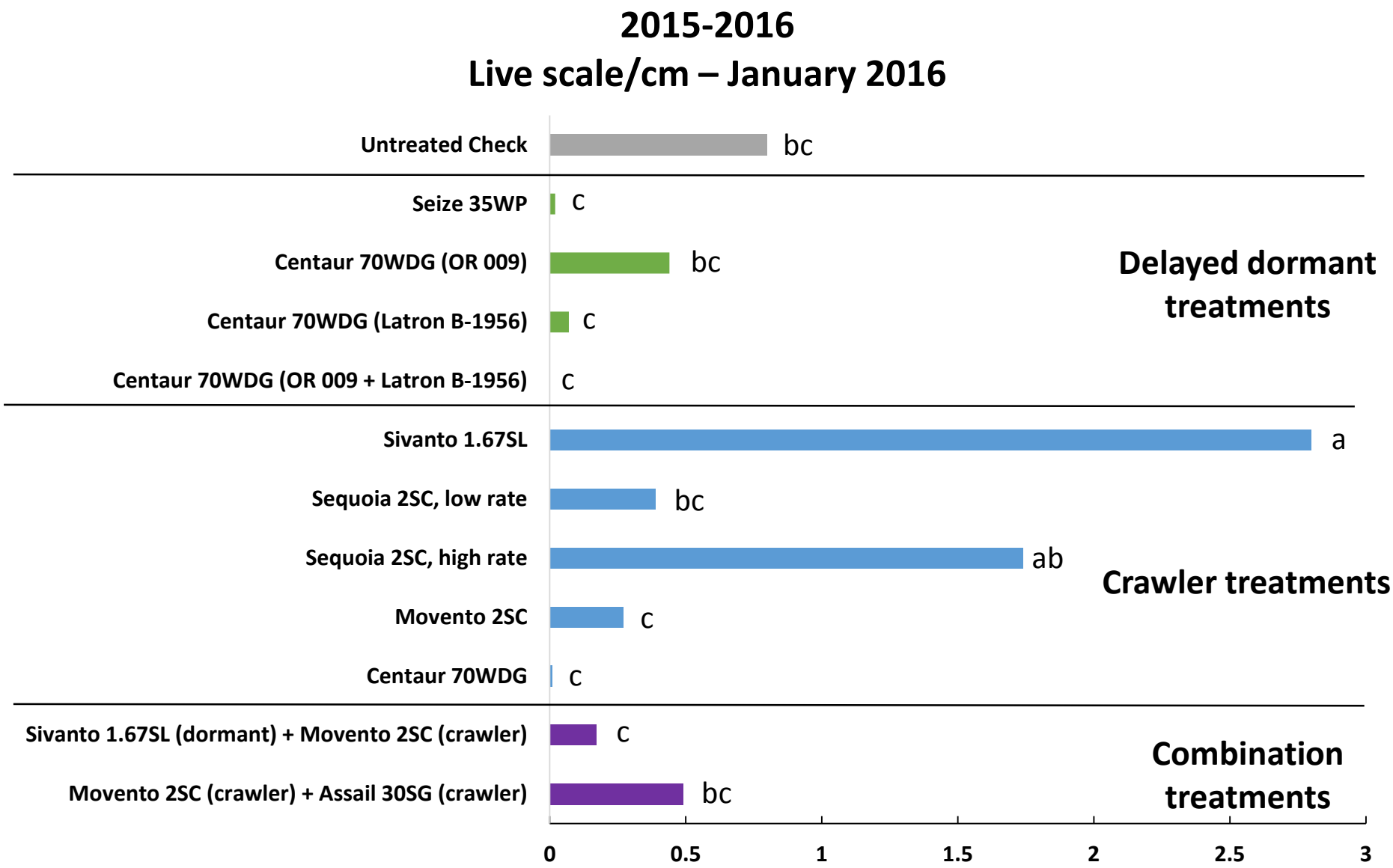
[a]Treatments included 0.0625% v/v Dyne-Amic
[b]Treatments included 0.25% v/v Latron B-1956
[c]Treatments included 0.5% v/v OR 009
[d]Treatments included 0.0125% v/v Latron B-1956

DD = delayed-dormant (12-March-2015)
C = crawler (12-May-2015)

2015-2016 Insecticide Evaluations



2015-2016 Insecticide Evaluations



2014-2016 Insecticide Evaluations

- **General Conclusions**

Generally performed better than untreated:	Mixed results (relative to controls):	Did not perform well (relative to controls):
Seize DD	Assail C	Sivanto C
Centaur DD	Brigadier C	Sequoia* C
Centaur C	Movento C	

- **Spring 2015 evaluations showed continued population suppression**
  - **Possible every 2-3 year treatment for scale**
- **Spring 2016 evaluations…**
- **Treatment thresholds based on Bot pressure?**

Walnut Husk Fly Management Update

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Insecticide Efficacy Trials – Van Steenwyk & Coates

- ‘Hartley’ orchard (Hollister, CA)
- High WHF populations
- Treatments applied with hand-gun orchard sprayer
  - Operated at 250 psi, final spray volume of 300 gal/ac
- 3 to 4 applications/year
  - Mid-late July, mid-August, late-August/early-September
- Treatments replicated 4 times (single tree replicates)
  - Included NuLure & Dyne-Amic or Latron-B
- Evaluated 125 nuts/rep before commercial harvest (mid-

Excellent Efficacy 95-100% Control
Leverage 360 2.8 fl.oz/acre beta-cyfluthrin (3A) and imidacloprid (4A)
Assail 6.0 oz/acre acetamiprid (4A)
Danitol + Belay 21.3 fl.oz + 6 fl.oz/acre fenpropathrin (3A) + clothianidin (4A)
Stallion + Brigadier 11.8 fl.oz + 12.8 fl.oz/acre bifenthrin (3A) and imidacloprid (4A) + zeta-cypermethrin (3A) and chlorpyrifos (1B)
Baythroid 2.8 fl.oz/acre beta-cyfluthrin (3A)

Good Efficacy
75-95% Control

Temitry
14.0 oz/acre
malathion (1B)
and gamma-cyhalothrin (3A)

Danitol
21.3 fl.oz/acre
fenpropathrin (3A)

Belay
6.0 fl.oz/acre
clothianidin (4A)

Assail
4.0 oz/acre
acetamiprid (4A)

Athena + Brigadier
20.0 fl.oz + 12.8 fl.oz/acre
bifenthrin (3A) and avermectin (6) +
zeta-cypermethrin (3A) and chlorpyrifos (1B)

Brigade + Brigadier
16.0 oz + 12.8 fl.oz/acre
bifenthrin (3A) +
zeta-cypermethrin (3A) and chlorpyrifos (1B)

Provado
7.0 fl.oz/acre
imidacloprid (4A)

Moderate Efficacy 50-75% Control
Athena 20.0 fl.oz/acre bifenthrin (3A)
Intrepid Edge 12.75 fl.oz/acre spinetoram (5) and methoxyfenozide (18)
Warrior 2.56 fl.oz/acre lambda-cyhalothrin (3A)
Belay 3.0 fl.oz/acre clothianidin (4A)
Delegate 3.2 oz/acre spinetoram (5)

Little Efficacy 20-50% Control	No Efficacy 0-20% Control
Cyclaniliprole (28) 16.4 fl.oz/acre	**Malathion (1B)** 64.0 fl.oz/acre
Exirel 20.5 fl.oz/acre cyantraniliprole (28)	**Bexar** 27.0 fl.oz/acre tolfenpyrad (21A)
	Altacor 4.0 oz/acre chlorantraniliprole (28)

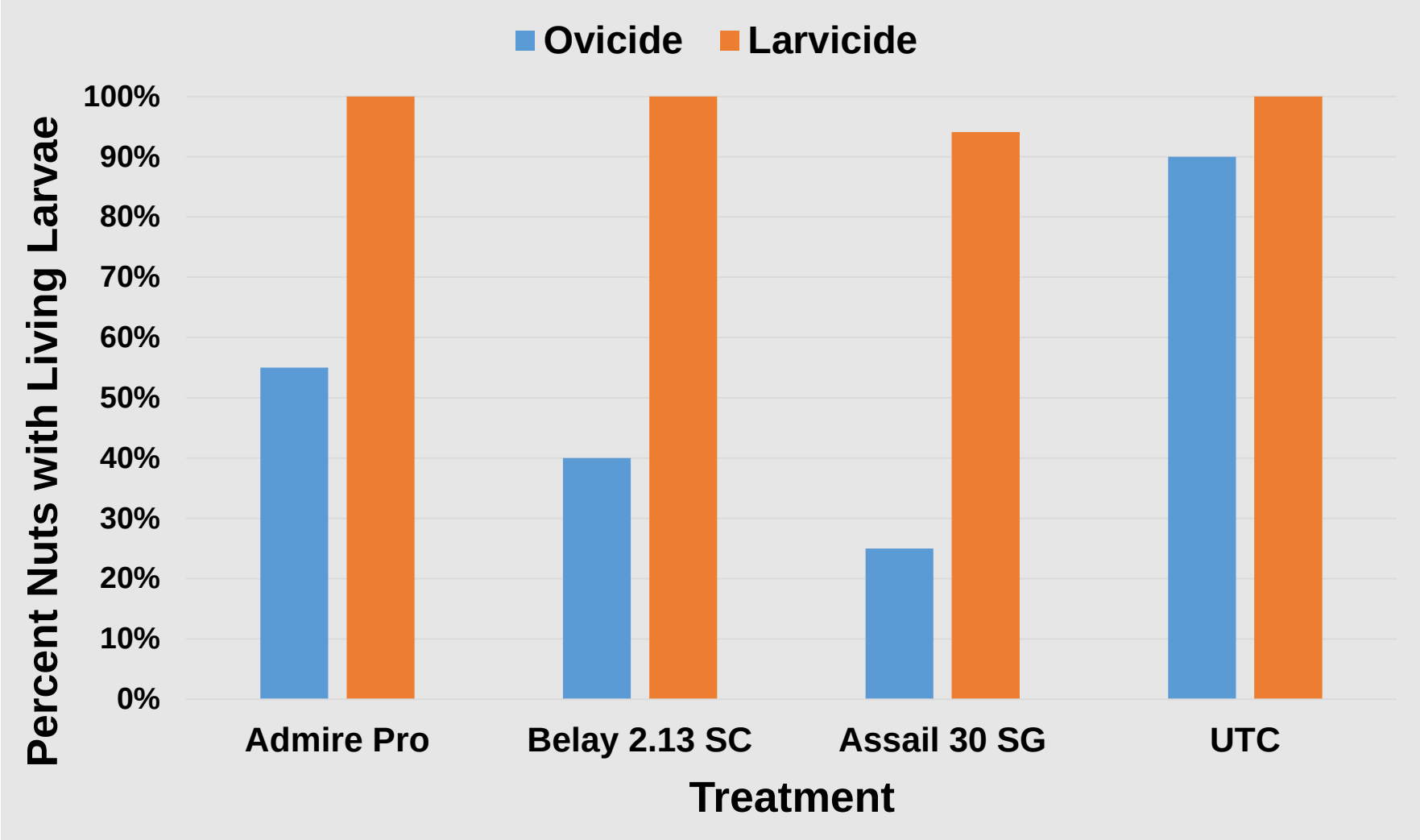
WHF Ovicidal & Larvicidal Effects – Van Steenwyk 2015

- **Nuts exposed to WHF – ave. 3 stings/nut**

- **Nuts dipped in max. label rate/100 gal., air dried, visually examined for egg hatch/larval feeding 3, 7, 10 days after treatment**
  - **Immediately after oviposition**
  - **7-10 days later (after larval feeding observed)**

- **3 treatments (neonicotinoids, 3A) + UTC, 20 replicates**
  - **Assail 30SG (2.4 fl. oz) – acetamiprid**
  - **Admire Pro (8.0 oz) – imidacloprid**
  - **Belay 2.13SC (6.0 fl. oz) – clothianidin**
  - **All with 0.125% v/v MSO (methylated seed oil)**

WHF Ovicidal & Larvicidal Effects – Van Steenwyk 2015



WHF Ovicidal & Larvicidal Effects – Van Steenwyk 2015

- **General conclusions**

- **All tested materials showed ovicidal activity**
  - **Very high exposure with dip method**
  - **Need to follow-up with exposure rates typical of field application methods**

- **Larvicidal activity not observed**
  - **Suggests that, once hatched, larvae are highly resistant to surface application of these materials**

- **Control at various life stages enables more leeway in spray timing**

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