Pest Management: Fine-tuning Spray Efficacy

December 8, 2016

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Almond Board of California

Pest Management: Fine-tuning Spray Efficacy

Ali Pourreza, University of California (Moderator)

Brad Higbee, Wonderful Orchards

Joel Siegel, USDA-ARS, Parlier

Matt Strmiska, Adaptiv

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Ali Pourreza,
University of California


Almond Conference
SACRAMENTO CA

Survey

Almond Spray Application

Almond Conference, Sacramento CA
December 6-8, 2016

goo.gl/bghXzy

10 Questions - 3 Minutes

Alireza Pourreza
CE Advisor
Agricultural Engineer Kearney
Agricultural Research &
Extension Center

Franz Niederholzer
Farm Advisor
Orchard Systems
Cooperative Extension
Sutter-Yuba Counties

University of California
Agriculture and Natural Resources

1. What is your main relationship to agriculture industry?

- ○ Grower
- ○ PCA or CCA
- ○ Supplier (fertilizer, pesticides, seed, machinery, etc.)
- ○ Regulation/policy
- ○ Scientist/researcher
- ○ Other : _____

2. What is your age?

- ○ 24 or younger
- ○ 25 - 34
- ○ 35 - 44
- ○ 45 - 54
- ○ 55 - 64
- ○ 65 - 74
- ○ 75 years or older

3. Who do you contact most often to obtain spray technology/application information?

- ○ University academics (Advisors, Specialists, Faculties)
- ○ PCAs or other industry reps
- ○ Other growers
- ○ Family
- ○ Not Applicable

4. Which of the following concepts are familiar for you? (Select all that apply)

- [ ] Precision Agriculture
- [ ] Variable rate technology/application
- [ ] Prescription map
- [ ] Yield map
- [ ] GPS (Global Positioning System)
- [ ] GIS (Geographic Information Systems)
- [ ] Remote Sensing

5. What kind of sprayer equipment do you own/use? (Select all that apply)

☐ Air Blast Sprayer

☐ Tower attachment

☐ Other:

6. Rank the following issues in almond spray application based on their priorities and importance?

	Slightly important	Medium important	Very important
Coverage	○	○	○
Efficacy	○	○	○
Calibration	○	○	○
Drift	○	○	○
Penetration	○	○	○

7. What practice have you conducted to improve spray coverage, and how it worked?

	Coverage improved	Coverage did not change	Coverage declined
Slower speed	○	○	○
Higher air pressure	○	○	○
Smaller droplet size	○	○	○
Use of tower sprayer	○	○	○

8. Is the status quo in spray application sustainable?

- ○ Yes
- ○ No
- ○ I am not sure

9. On a scale of 1 to 5, how satisfied are you with your current spray application?

	1	2	3	4	5	
Least satisfied	○	○	○	○	○	Most satisfied

10. What is your preferred way of receiving information from UCCE?

- [ ] Personal Contact
- [ ] Printed Material
- [ ] Electronic form (Email, e-newsletter, blog, website)
- [ ] Smartphone application
- [ ] Educational Video
- [ ] Online training tool
- [ ] Field day and workshop
- [ ] Podcast

Optional

Email

Your answer

First name

Your answer

Last name

Your answer

SUBMIT

Thank you very much for your time!

Brad Higbee, Wonderful Orchards

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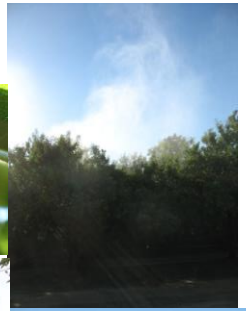
Navel Orangeworm Control in Almonds – the Challenge of Delivering Residues to the Target Site




Bradley S. Higbee

Director, Entomology Research

Wonderful Orchards

Bakersfield, CA

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NOW Control in Almonds

- Past – heavy reliance on Ops, then pyrethroids
- Current – pyrethroids less effective
- Diamides, IGRs, MD
  - Primarily ovi-larvicides
  - Target site for residues is the almond hull/nut
  - Suspected problems
    - Canopy density
    - Spatiotemporal dynamics of hull splitting (=susceptibility)

Currently Available AIs in Almonds

Active Ingredient	IRAC Number	MOA
Bifenthrin	3	Sodium channel modulators
Lambda-cyhalothrin	3A	Sodium channel modulators
Chlorantraniliprole	28	ryanodine receptor modulators
Flubendiamide	28	ryanodine receptor modulators
Methoxyfenozide	18	ecdysone receptor agonists
Spinetoram	6	chloride channel activators
Emamectin benzoate	5	nicotinic acetylcholine receptor agonists

Spray Coverage in Almonds 2010-2016

- Objectives:
  - Characterize and quantify spray coverage at various elevations and positions within the tree canopy.
  - Test and compare ground speeds, spray volumes, nozzling, adjuvant type and concentration, airspeed, and machine type (engine drive, PTO, tower, etc) in an effort to improve performance of the residual insecticides used in this test against NOW.
  - The standard used to compare against each year is the Air-O-Fan (AOF) engine drive (D2-40) at 2 mph delivering about 200 gals/acre.

Application Variables

Residue Placement on the nut

Tree height

Redistribution (or not)

Sprayer Speed

Shadowing

Hull Split %

Sprayer type

Hull Split by Variety

Electrostatics

PHI

Spray Coverage

Tower

Adjuvant Rate

Fan Air Speed

Nozzle Type

Spray Timing

Adjuvant type

Tree Density

Spray Mixture

Droplet Size

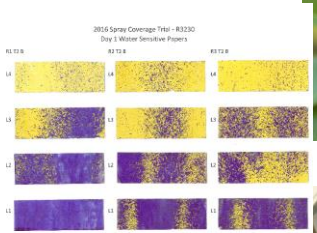
Temperature

Gallons/Acre

Number of Sprays

Spray Pressure

Evaluation



Analysis of spray coverage included 3 measures

- Water sensitive papers (% coverage)
- Product residue on nuts (micrograms/nut)
- Efficacy (% infestation or damage)

Each year, 1,500 – 2,000 individual nuts analyzed for product residues, 200-400 WSPs scanned, and 150,000+ nuts dissected for infestation and damage.

1. Water sensitive paper is great for a qualitative assessment
2. Residue analysis on nuts quantifies product placement
3. Efficacy is where the rubber meets the road, but you need the first 2 to understand how to get there

<u>Spray Coverage</u> comes in many varieties

– For NOW and the products tested, residues must be deposited on the hull/nut

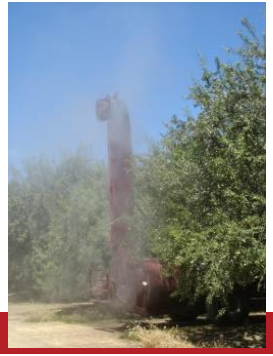
Machines Tested 2010-2014

Air-O-Fan D-240
200 gals/ac @ 2 and 2.5 mph

Progressive Ag 2650

Progressive Ag 3 head
2650 w/ 16 ft tower

Progressive Ag Tower
150 gals/ac @ 3 mph



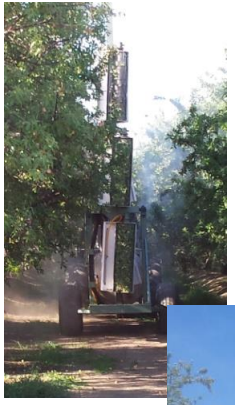
Bell 206
30 gals/ac @ 30 mph

Blueline Accutech
10 head tower

Machines Tested 2015

Rears PTO 38” Fan

Curtec AC 1000
TRX cone jet
nozzles



Progressive
Ag Tower

Air-O-Fan D-240
Disc and core hollow cone

Air-O-Fan D-240
TRX cone jet nozzles
Maximal configuration

Air-O-Fan 232 PTO
1000 gal tank
Hollow cone

Machines Tested 2016

Rears PTO 38” Fan

ZeferSpray PTO
TRX cone jet
Nozzles – 4/fan

Progressive
Ag Tower - PTO

Air-O-Fan D-240
Disc and core hollow cone

Air-O-Fan D-240
TRX cone jet nozzles
Minimal configuration

Air-O-Fan 232 PTO
1000 gal tank

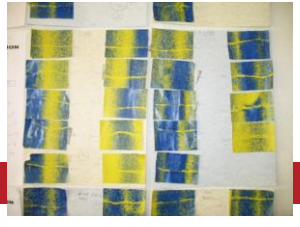
Nelson-Hardie PTO 34” twin fans

Experimental Variables Targeted – 4 Seasons

Variable	2010	2011	2012	2013
Spray Volume (GPA)	50, 200	50, 200	150, 200	30, 150, 200, 400
Sprayer Type (AirBlast, Tower, Helicopter)	Air-O-Fan, Electro, Towers	Air-O-Fan, Electro Tower	Air-O-Fan, Electro Tower	Air-O-Fan, Electro Tower, Helicopter
Sprayer Speed (mph)	1.5 – 4	2 – 4	2 - 3	2 – 3 (30 H)
Spray Nozzle Type	Disc/Core, Air Shear	Disc/Core, Air Shear	Disc/Core, Full Cone, Flat Fan, Air Shear	Disc/Core, Air Shear
Nozzle Configuration	Varied	5 configs of Disc/Core	Varied	Varied
Adjuvant	LI-700@0.125%	LI-700@0.25%	Dyne-Amic@0.5%	Non-Ionic@.125%
Spray Timing	Single Spray @ 1 - 5%	Single Spray @ 1 - 5% HS	2 Sprays (1 mo apart) 2%/50%	2 Sprays (1 mo apart) 1%/60%
Vertical Spray Proportion				✓
Multiple Applications			✓	✓

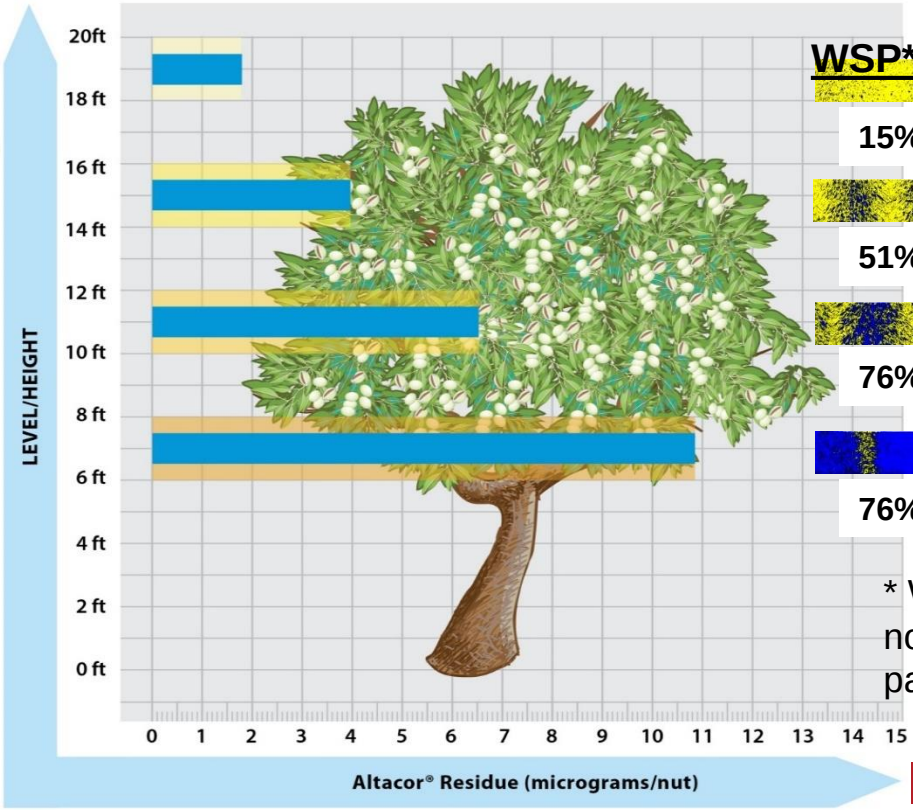
Summary 2010 – 2014 Trials

- First 4 years of testing showed that spray coverage in the upper ½ to 1/3 of trees was limited
  - Towers helped improve upper tree coverage significantly, but lower canopy coverage was not as good as the standard AOF.
  - NOW Infestation levels highest (3-4x) in upper half of canopy
- Application Variables such as nozzle type, adjuvant, droplet size did not have significant impacts on efficacy
  - Small positives with full-cone nozzles, using dual spray booms with small hollow cones, DyneAmic adjuvant (2012), electrostatic at 3 mph
- Number of Applications an important factor
  - 2012 -13 had a solid increase in performance with 2nd spray
  - Residues were relatively stable and are additive
- Damage reductions typically 15-25% with a single application in initial trials vs. 55-60% with two applications in subsequent tests.



Air-O-Fan Spray Coverage (2 sprays)

- Extremely rugged design
- 100 mph, Hi Volume air
- Nozzle flexibility a plus
  - Multi-Boom



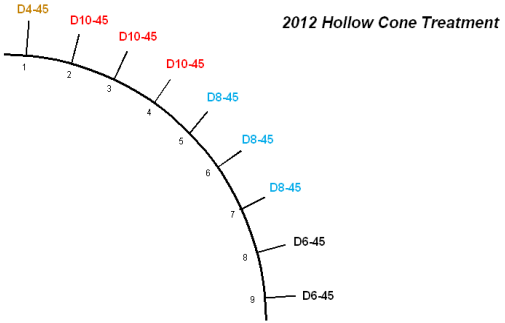
WSP*	% infested
15%	20
51%	8
76%	5.8
76%	5.7

* WSP mean values do not indicate individual papers

2013 Trial

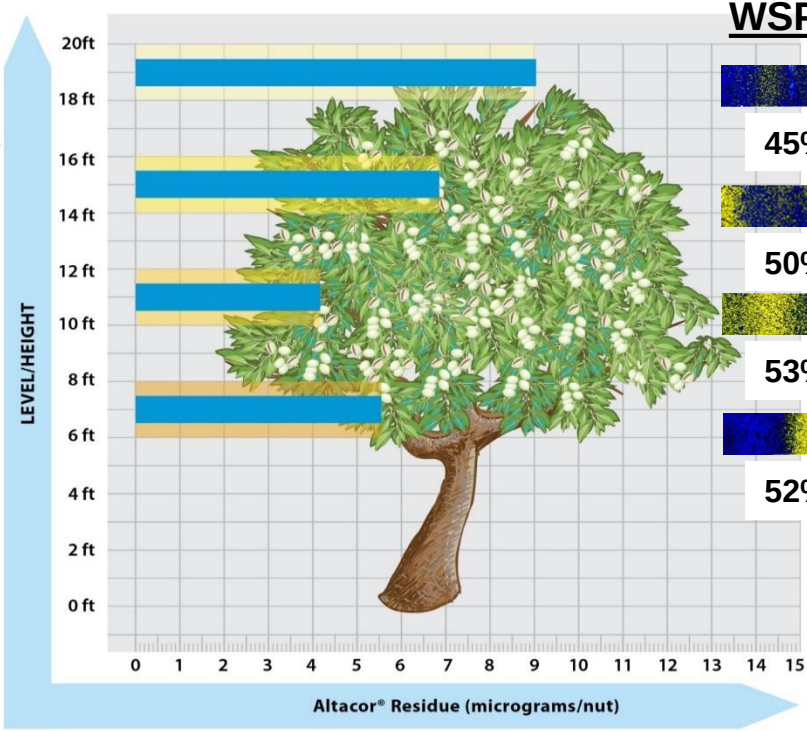
Challenging Coverage Due To Shadowing, Angle

- Lower branches/leaves block spray targeting upper level
- Too many nozzles targeting lower level – restrictive radius
- Proportional nozzle sizing? – largest in red (Did not help)
- Begs for a short tower



Electrostatic Tower Spray Coverage (2 sprays)

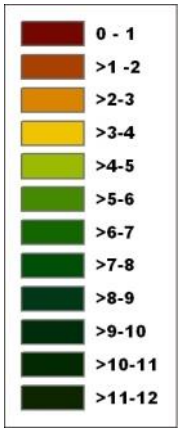
- Multi-head Towers – Very Good Coverage
- 10,000 Volt Charge – small droplets
- High Velocity Air (200 mph)
- Higher Speed: 3-4 mph
- Air shear

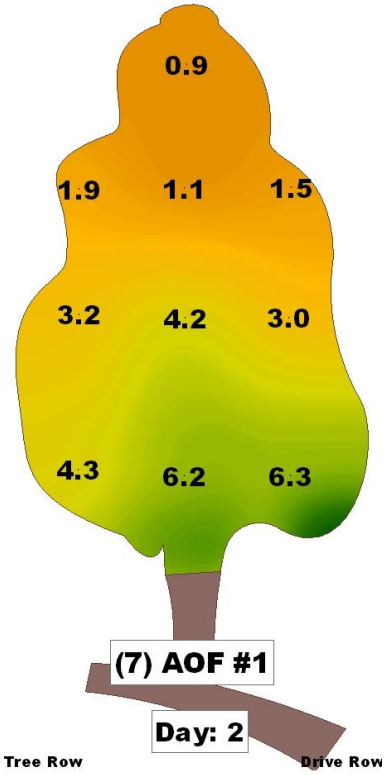


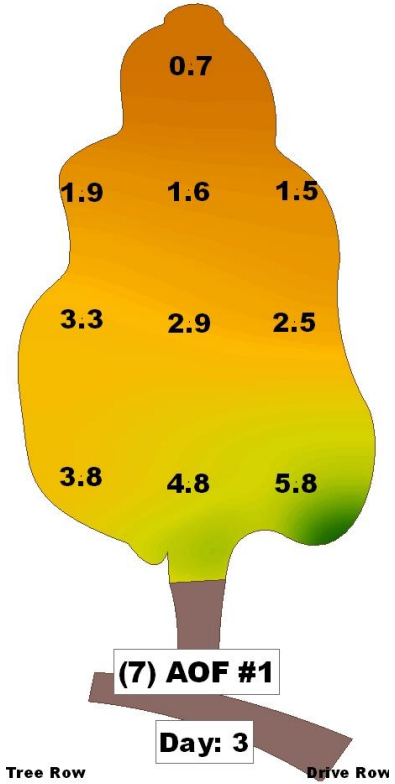
WSP*	% infested
45%	33
50%	12
53%	5.7
52%	7

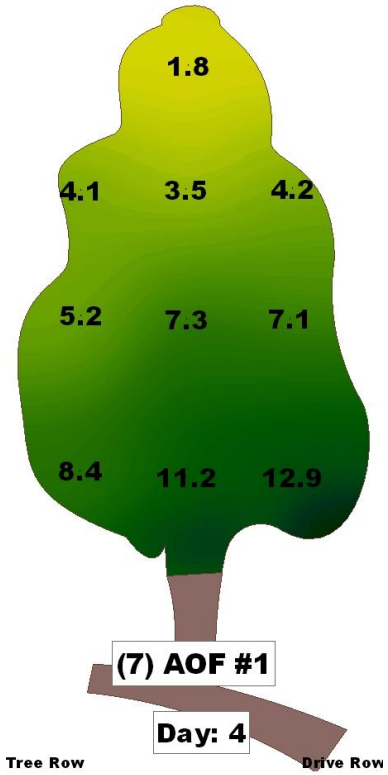
* WSP mean values do not indicate individual papers

2013 Trial









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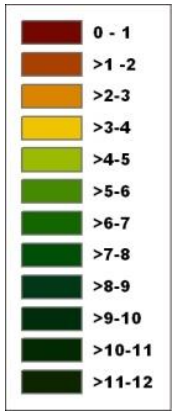

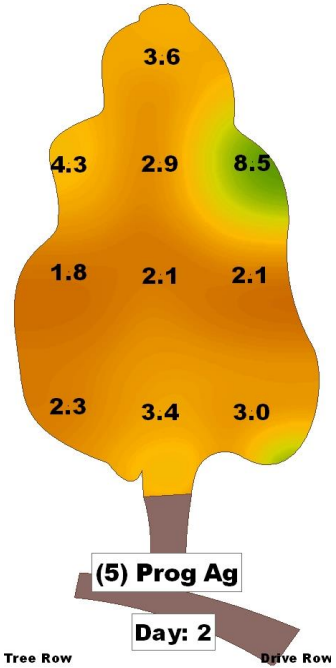

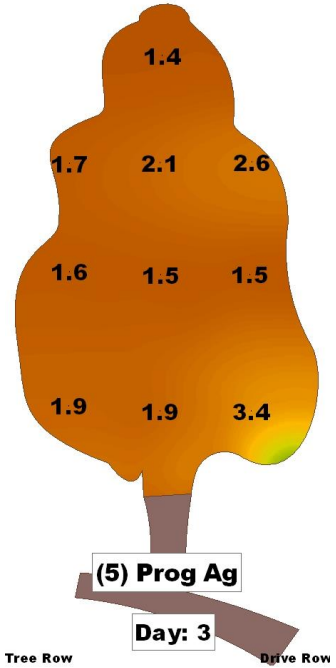

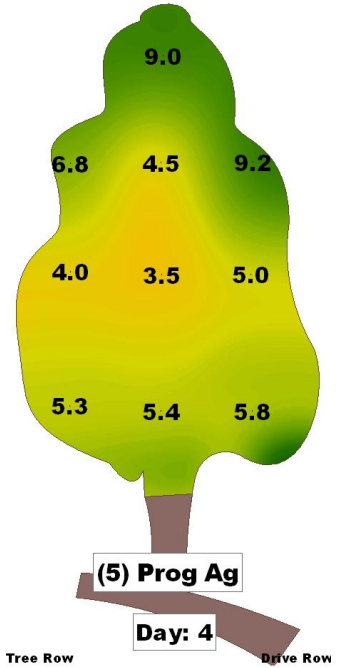

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100% Coverage by Dipping Nuts

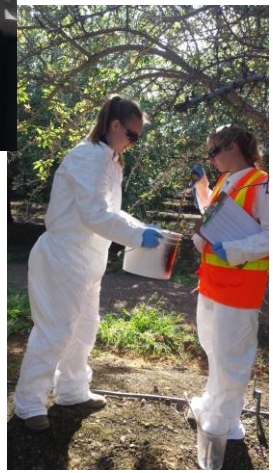
NP dipped at each spray timing (3x)
Mo only dipped at final spray timing (1x)

Each nut numbered

Mix spray solution

Determine maturity status

Dip nut for
5 secs



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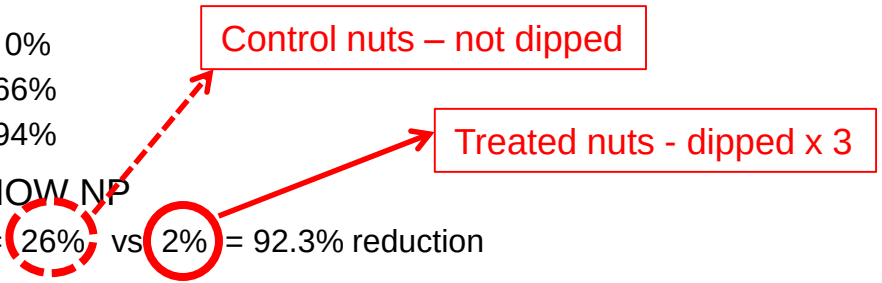
Wonderful Orchards

2015 Nut Dipping - NP

- At each of the 3 spray application timings, 300 NP nuts were dipped for 5 secs in the spray tank solution.
- Interior trees, 5-6’ from ground.
- % NP split:
  - June 19 = 0%
  - July 17 = 66%
  - July 24 = 94%
- Aug 17 - % NOW NP
  - Damage = 26% vs 2% = 92.3% reduction
- Many dead neonates on treated nuts (96.4% vs 7.4% of larvae were dead)
- Therefore: Under heavy pressure, the best this 3 spray program can achieve is 2% damage, or a reduction of 92%!



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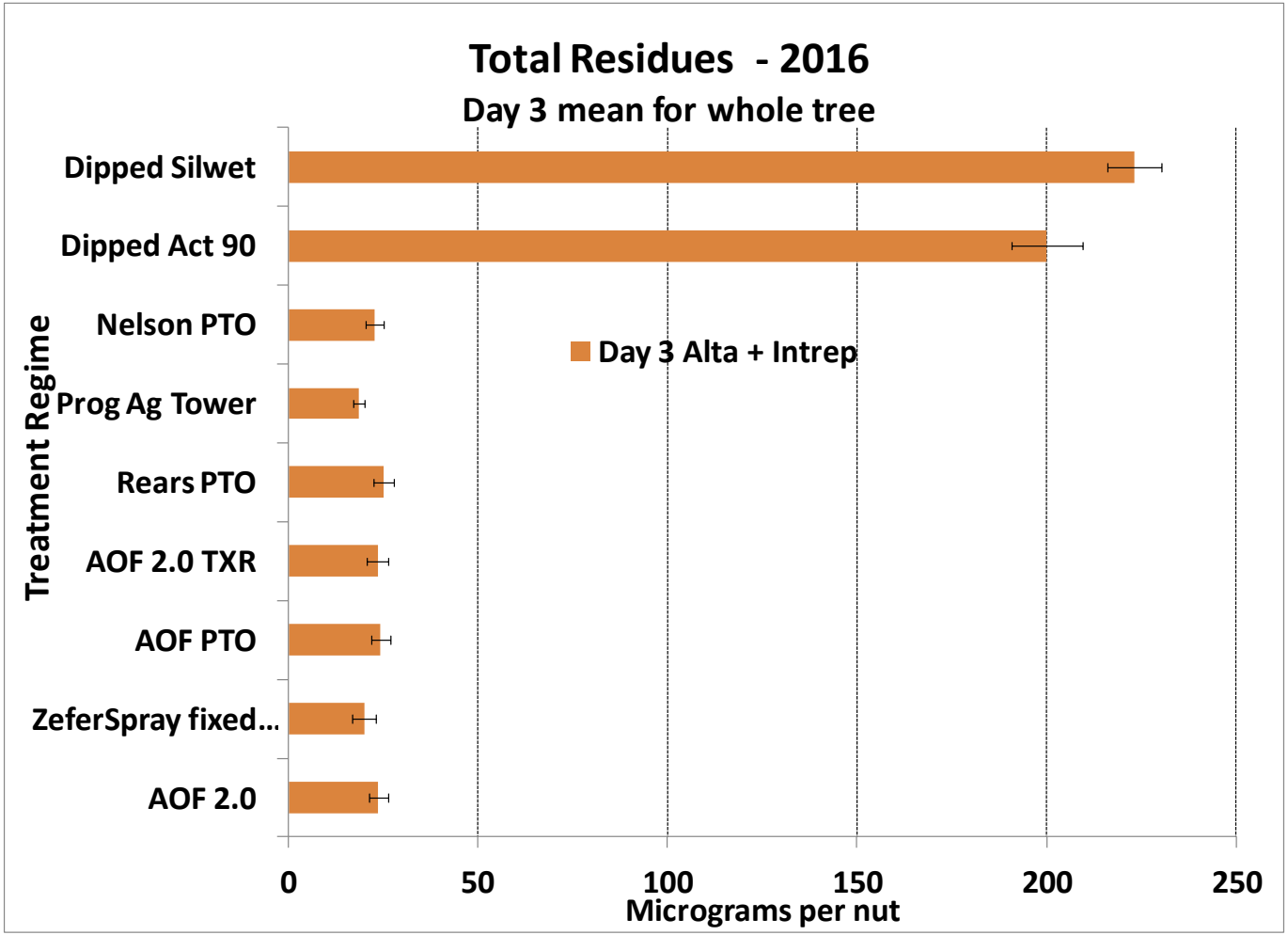
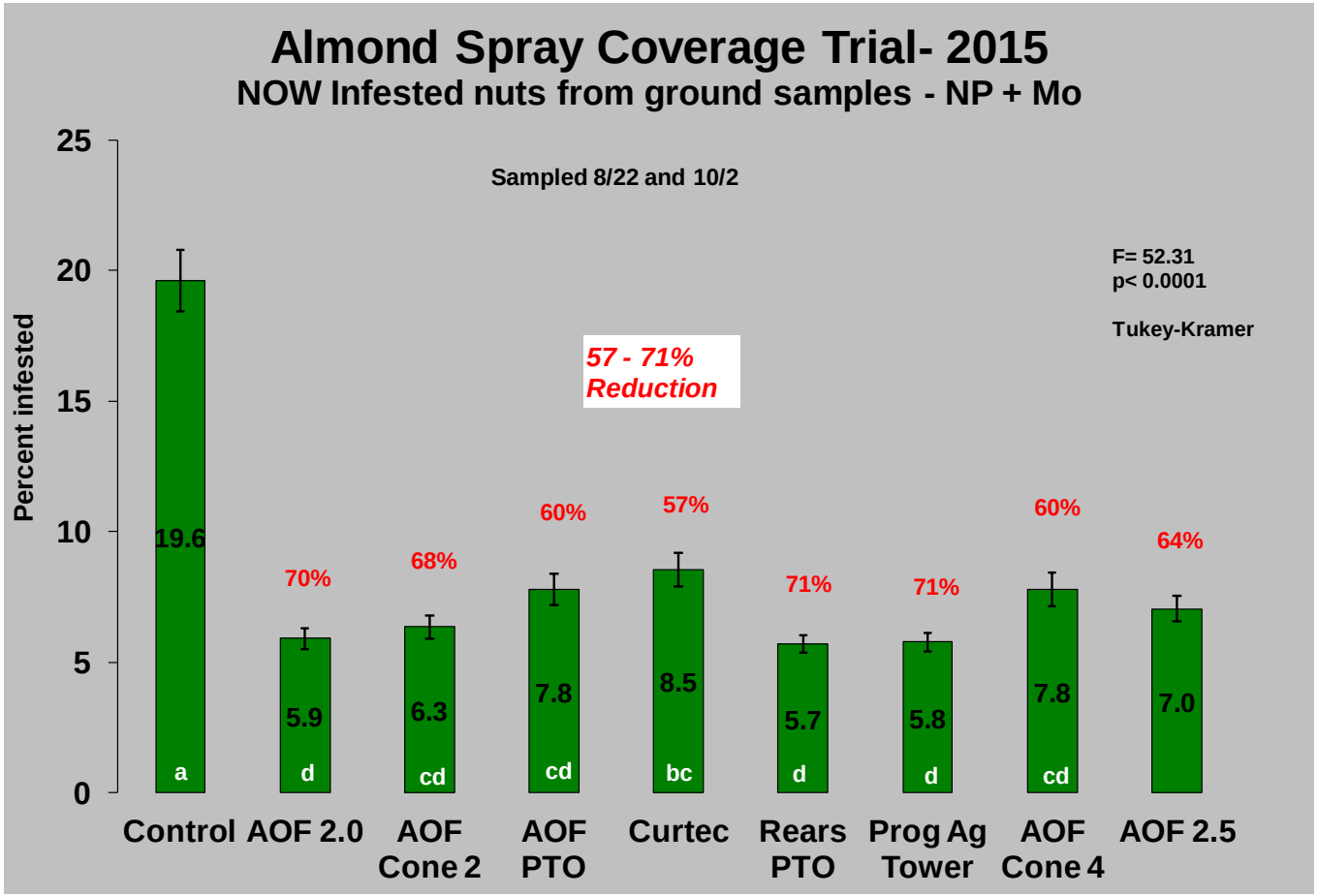

Total Residues - 2016
Day 3 mean for whole tree
Dipped Silwet
Dipped Act 90
Nelson PTO
Prog Ag Tower
Rears PTO
AOF 2.0 TXR
AOF PTO
ZeferSpray fixed...
AOF 2.0
Treatment Regime
Day 3 Alta + Intrep
0
50
100
150
200
250
Micrograms per nut



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Wonderful Orchards.

Spray Coverage

- Under the conditions of the 2015 trial (≈ 30% infestation, 3 sprays) max potential is 92% damage reduction
- The standard ground application @ 2 mph (AOF) remains the among the best. **But,** above 12 ft there is a severe dropoff in coverage and residue deposition.
- PTO based machines look as effective as engine drive
- Large arrays of XTR (AKA Cone-jet) nozzles did not provide any significant advantage at 2 mph, but may have potential at higher speeds (4 mph in this trial)
- The Progressive Ag tower is a top performer, but not sig better than the standard AOF application

B. Higbee, Wonderful Orchards.

Spray Coverage (cont)

- Residues from serial applications are additive and relatively stable
- Helicopter applications in combination with ground applications did increase residues in the upper canopy, but did not result in greater damage reduction relative to the standard AOF application.
- The addition of a 3rd spray increased damage reduction up to 80%
- Hulls splitting after application are likely an impediment to 100% control

B. Higbee, Wonderful Orchards.

Keep your equipment well maintained and calibrated properly

Acknowledgements

Dupont Crop Protection – Ray Kazmarcyck

Wonderful Orchards

WO Entomology Research Group

Wonderful orchards™

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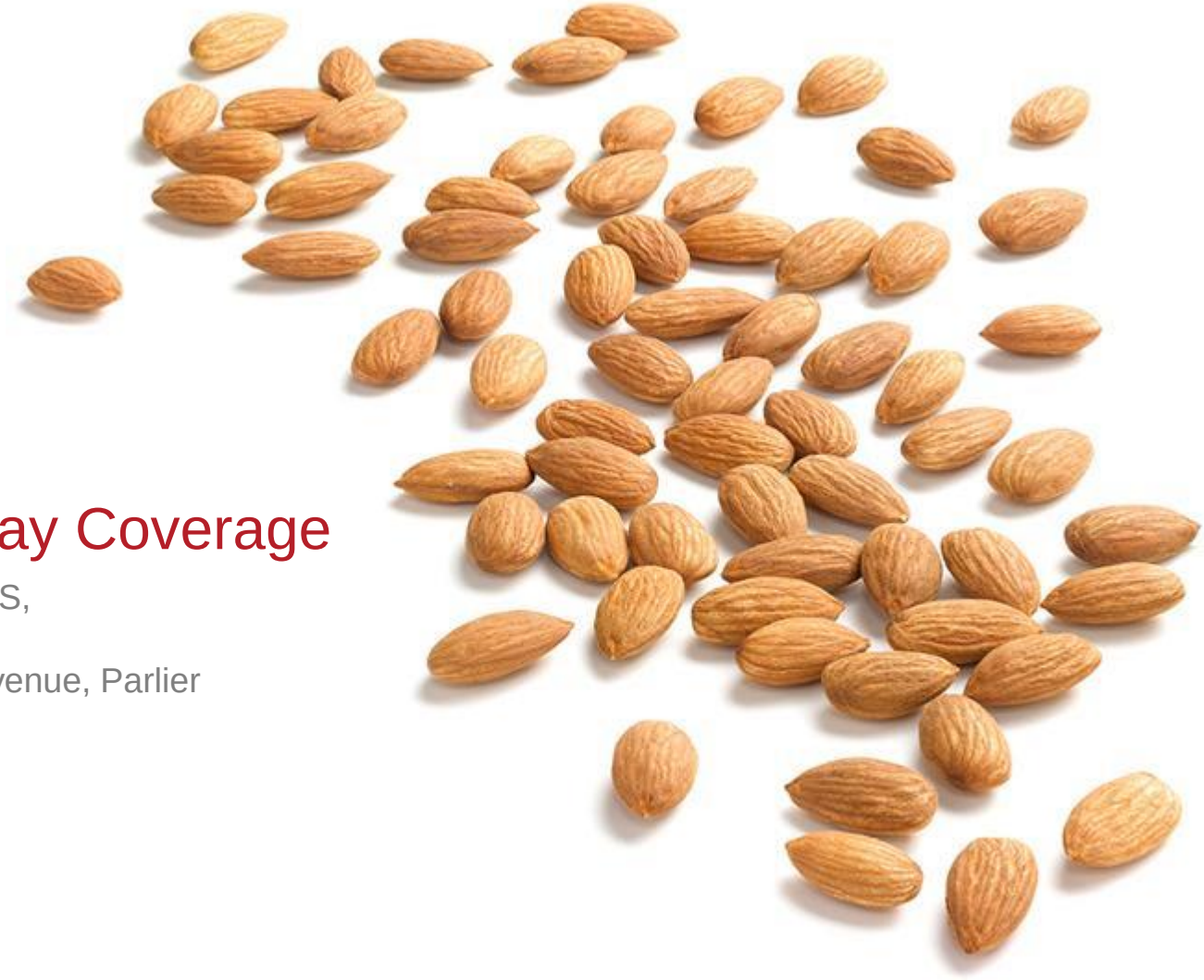
Kyle Lemucchi	Sarah Gooder
Eddie Placentia	Cristian Higuera
Vince Phillips	Ricardo Trigueros

Joel Siegel,
USDA-ARS, Parlier



Assessing Spray Coverage

Joel P. Siegel, USDA-ARS,
SJVASC, CPQ
9611 South Riverbend Avenue, Parlier

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Thanks to DuPont for sponsoring this research, also Dow AgroSciences, Almond Board of California, Pistachio Research Board

Work done in collaboration with Matt Strmiska, Adaptiv

Half-life

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Pretend that the dose needed for control is **10** units

Chemical has a half life of **7** days

You want **28** days of control

You need to deposit at least 4 half lives of material, or **160 units**

Target?

Go for the most challenging zone:
the suture

Hull vs Suture

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How critical is the suture?

Survival, Suture vs Hull:

1.24X greater in suture

With insecticide:

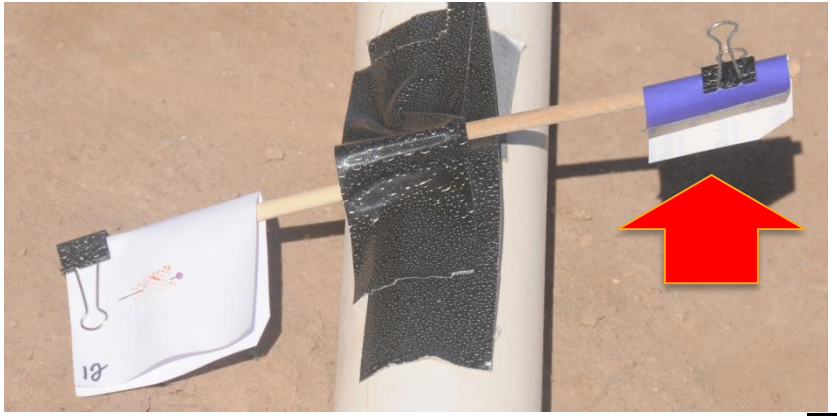
T_0 = NO Difference

T_{14}=1.8X increase in survival, P< 0.0001

46,610 eggs, 4,661 almonds

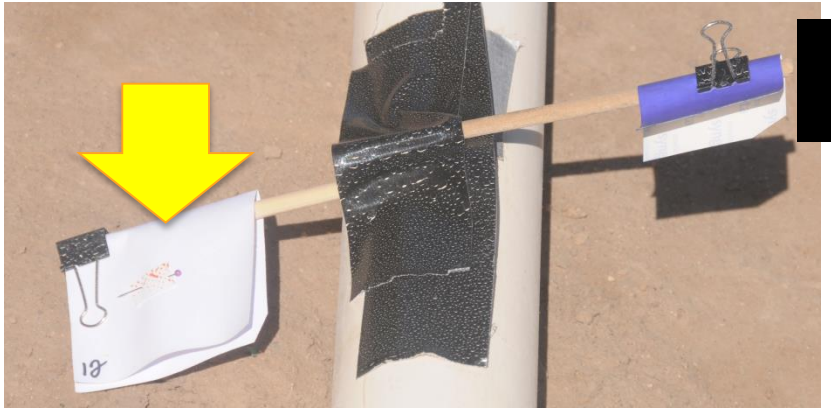
How much reaches target?

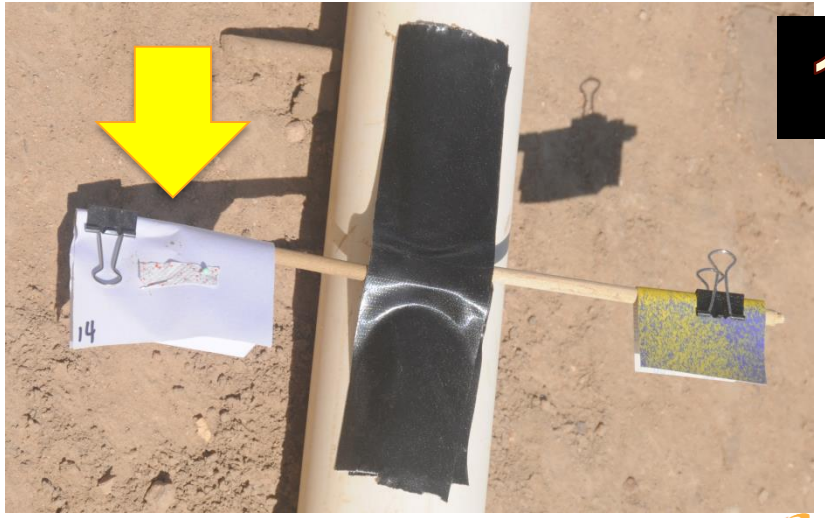
Vertical Component



Other ways to measure? My contribution

- Addition of Biological Targets





Aerial Bifenthrin + Cypermethrin (Mustang) Sept 11, 12.5 oz/ac total, 20 gpa

Contact Mortality GOOD

Height	Mortality	Eggs
6	57.2%	1,150
10	66.5%	400
12	68.3%	400
14	82.0%	400
16	84.0%	400
18	87.0%	4600
Overall	**70.1%**	**7,350**

Ultimate Combination

Frank Zalom, UC Davis

How much reaches target?

Assume 90% loss

Pretend that an Acre is a Flat Carpet

4,046,856,000 mm^2 (= 1 acre)

Start with Altacor at 4.5 oz/ac:
= 44,650,515,000 nanograms applied
= 11.033 nanograms/mm^2

11

Whole Nut: 1,596.4 nanograms at 15 feet;

1.11 nanograms per mm²

Loss is 89.97%

Intact Shell: 202.1 nanograms per nut

Loss is 87.3% compared to whole nut

Using 1,441.9 mm² as area of hull

Total loss compared to tank:

98.78% or only 1.22% reaches suture

Filter Paper Theory:

11.03 nanograms mm^2

Recovery: **0.997** nanograms mm^2

Loss is 90.97%

Filter Paper in Suture:

0.33 nanograms per mm^2

Loss is 67.3% compared to filter paper outside

Total loss compared to tank:

97.05% or **2.95%** reaches suture

Loss is 97.1 – 98.8 %

Only 1.2 – 3 % of applied material reaches suture!!!

Thank You

Matt Strmiska, Adaptiv

The 80/20 Rule of Spraying

How To Get More From What You Own

Matt Strmiska
Adaptiv

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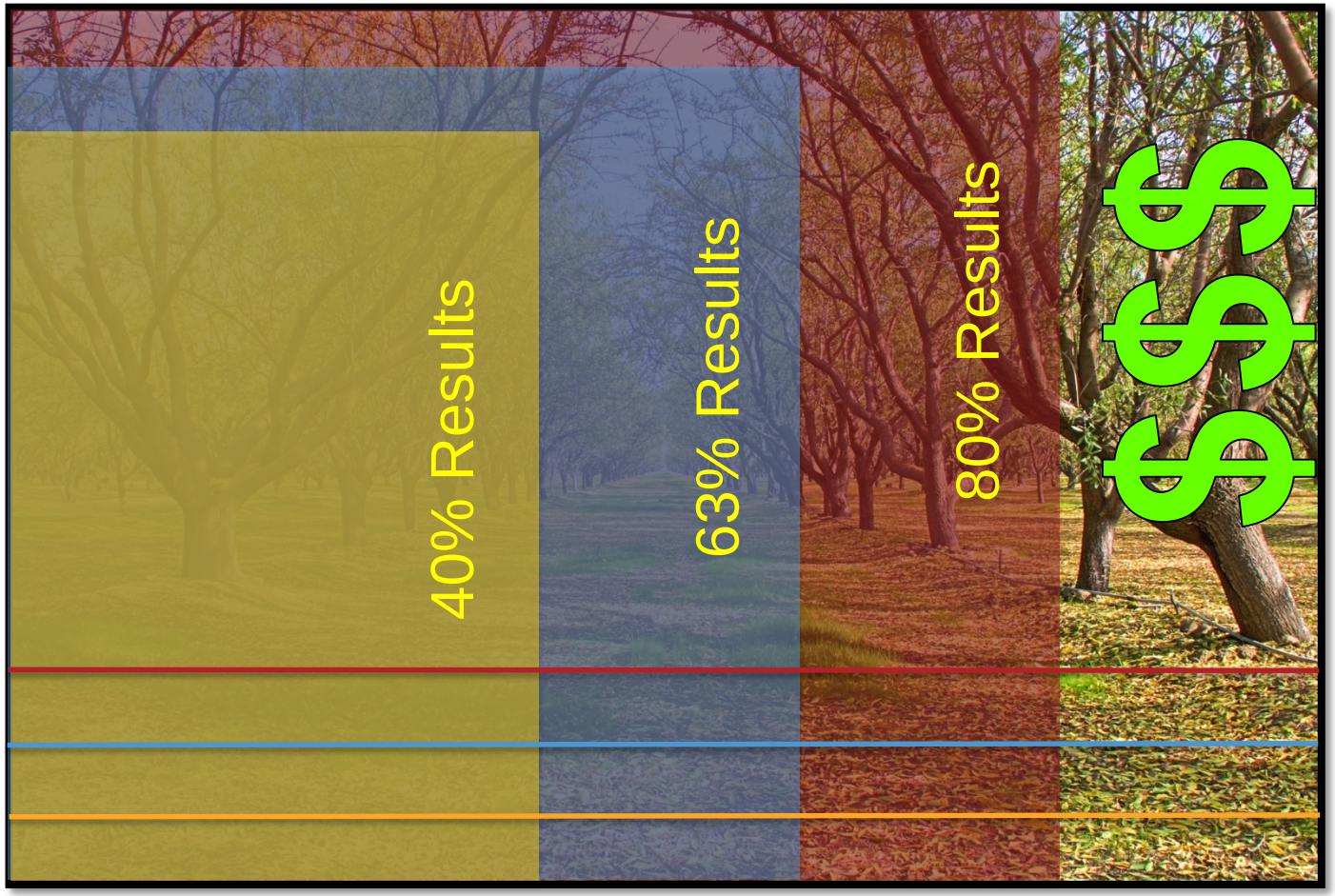
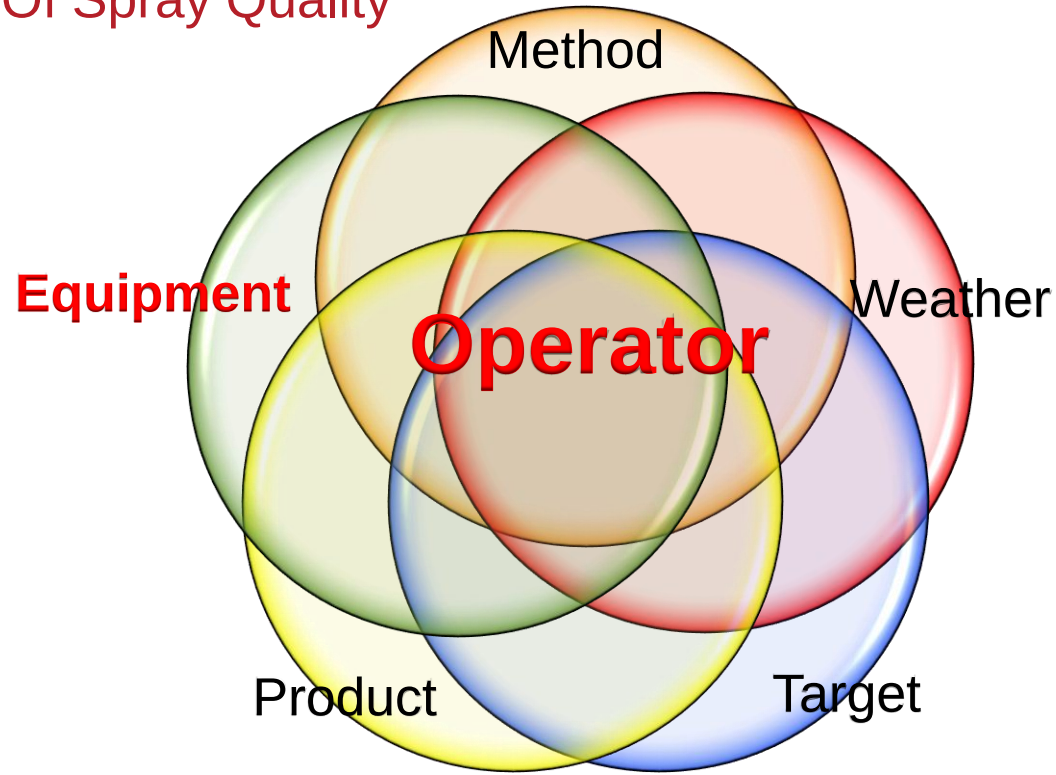
Pareto Principle

It is easy to get started and see immediate results, but investing 4x the effort will double your results.

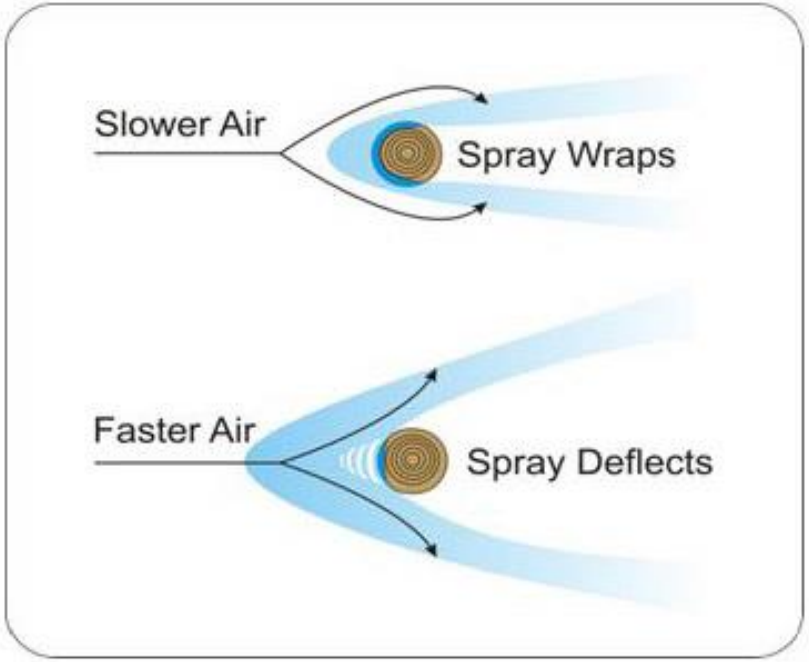


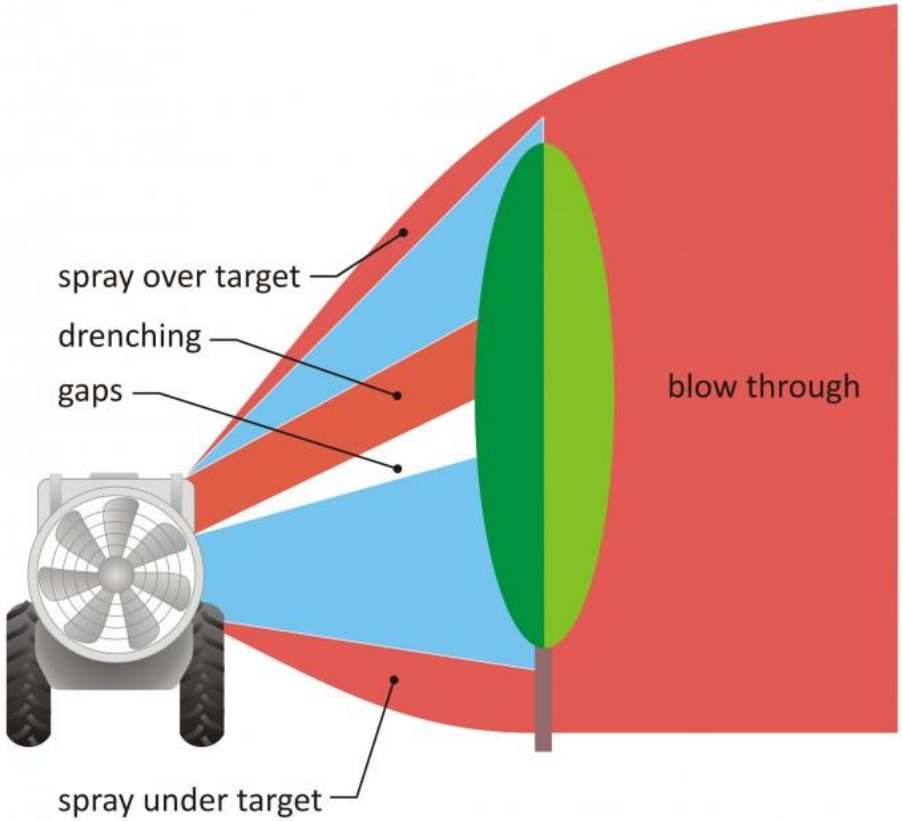
ADAPTIV

Effort In Understanding Factors Of Spray Quality



Thinking About Air





Jason Deveau Sprayers101.com images

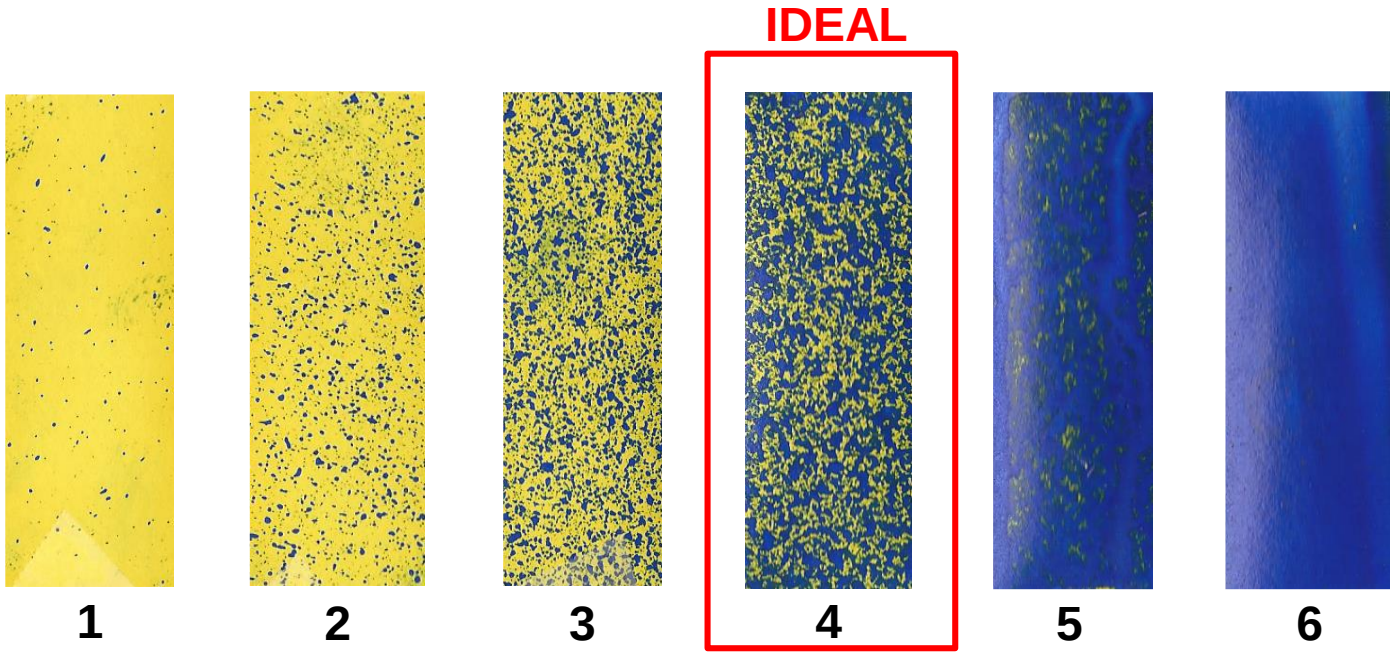
Applying Air with Effort

If you're assuming what you want is happening, then your assumption is incorrect.

The air must adequately reach your target.

Waste as little air as possible when reaching your target.

Effort To Know Coverage



These cards represent a range of results and are correlated (P = .0003) with percent kill of Naval Orangeworm in contact toxicity bioassays.

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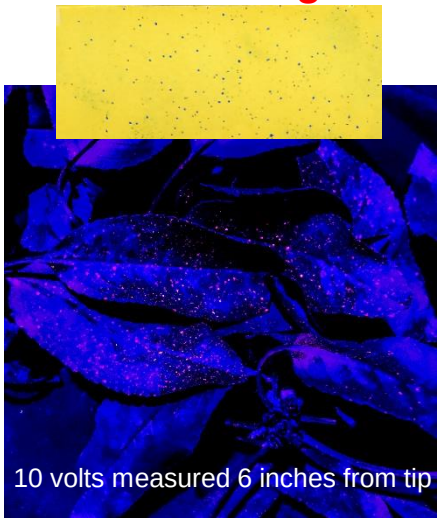
Effort With Machine Selection

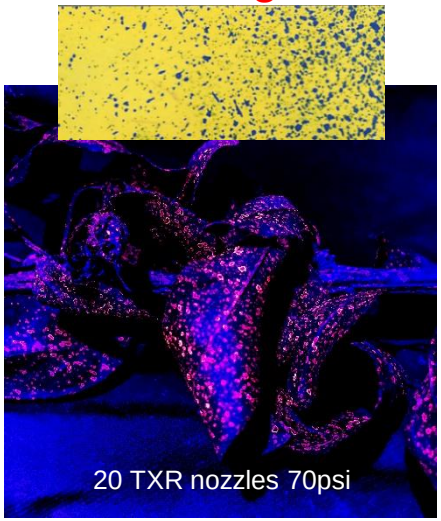
Samples taken at 13 feet
1 to 2 mph winds
Minimal prune : 20’ tall almonds

Card Rating 1



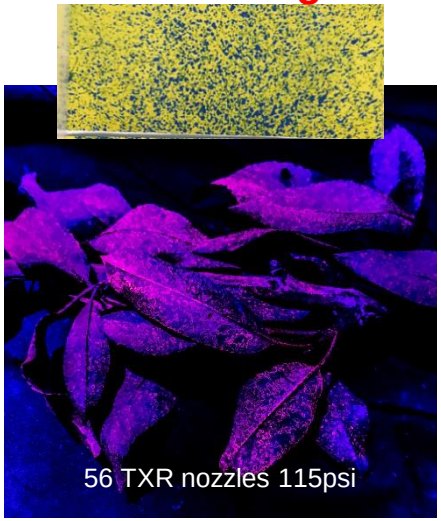
PTO LectroBlast 36”
4mph - 50gpa

Card Rating 2.5



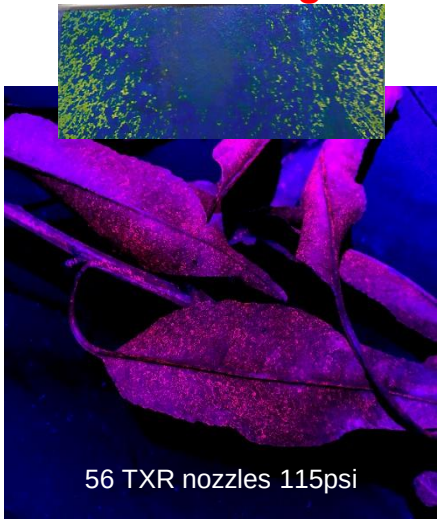
PTO Rears 33”
2.7mph - 100gpa

Card Rating 3



PTO Air-o-Fan 2/32”
2.7mph - 100gpa

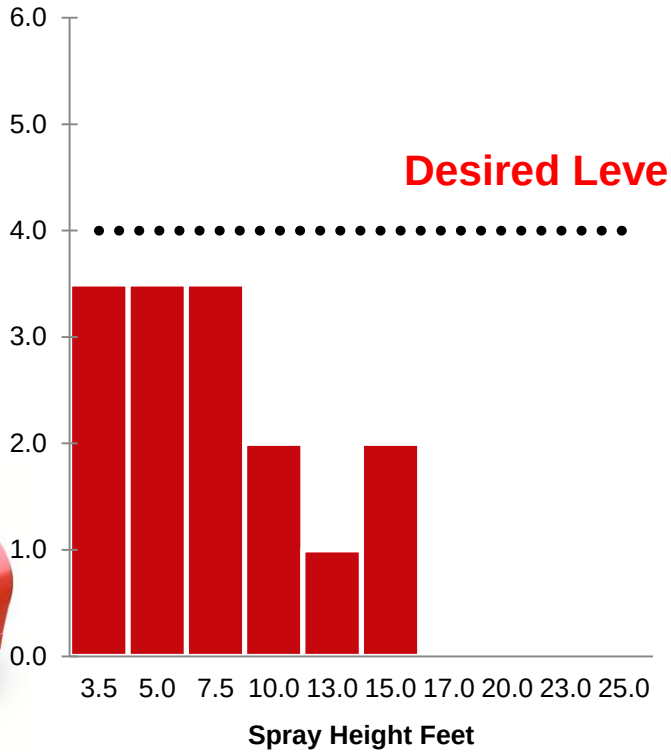
Card Rating 4



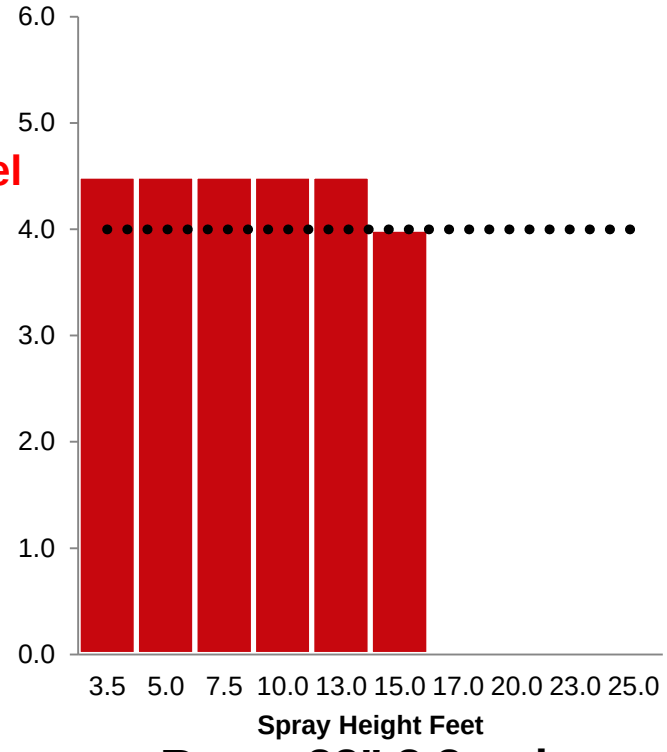
Engine Air-o-Fan D40R
2.7mph - 100gpa

Independent trial: LectroBlast and Air-o-Fan manufacturers present. Testing against grower-owned Rears Mfg. sprayer.

Effort With What You Own

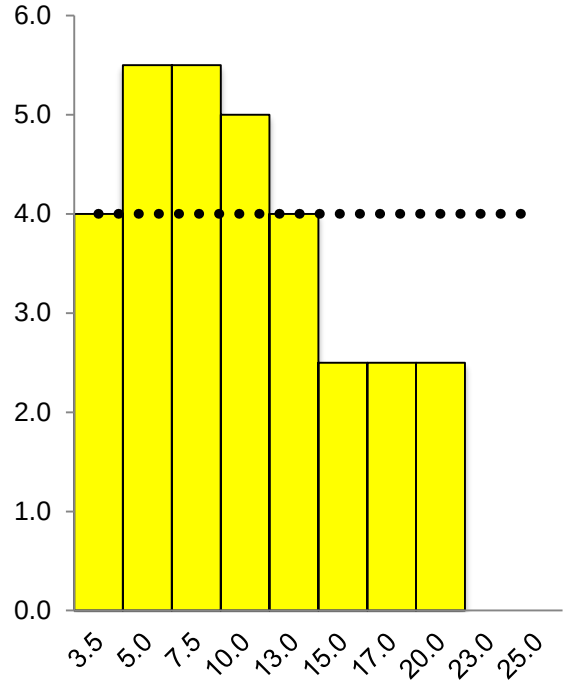


Rears 33" 2.7mph 130gpa DC (old pitch blades)

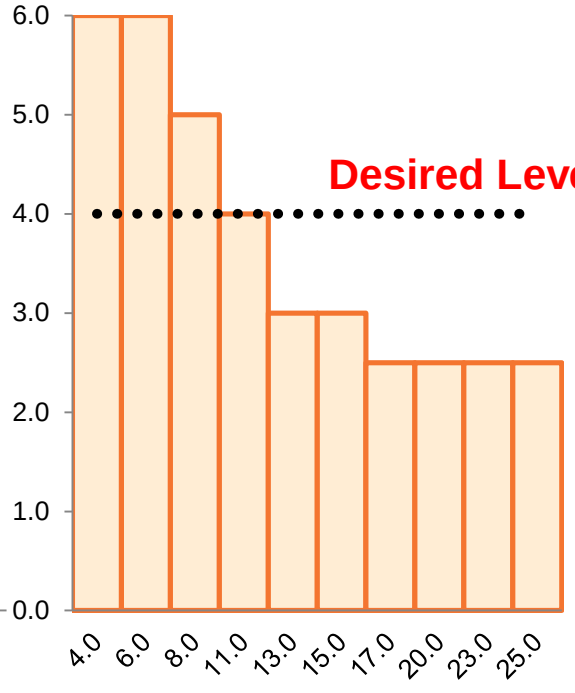


Rears 33" 3.3mph 100gpa 20TXR (new max pitch blades)

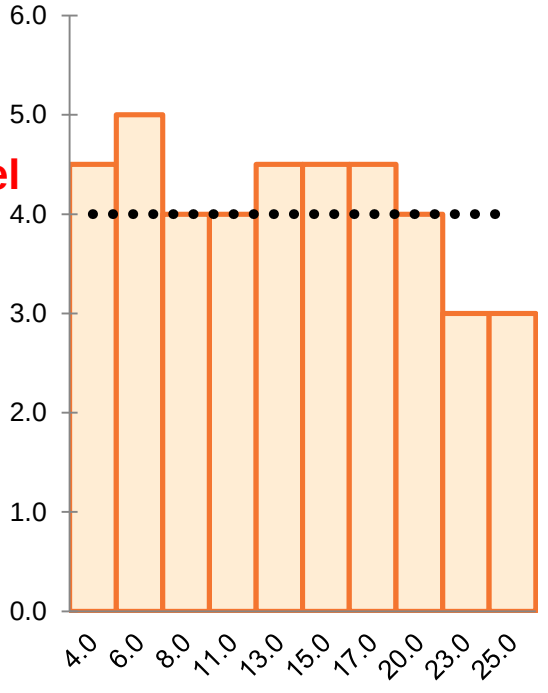
Effort With What You Own



AOF GB36R 2.5mph 120gpa 36TXR



John Bean 44" 2.5mph 105gpa 36TXR 1700RPM



John Bean 44" 2.5mph 105gpa 20TXR 2100RPM

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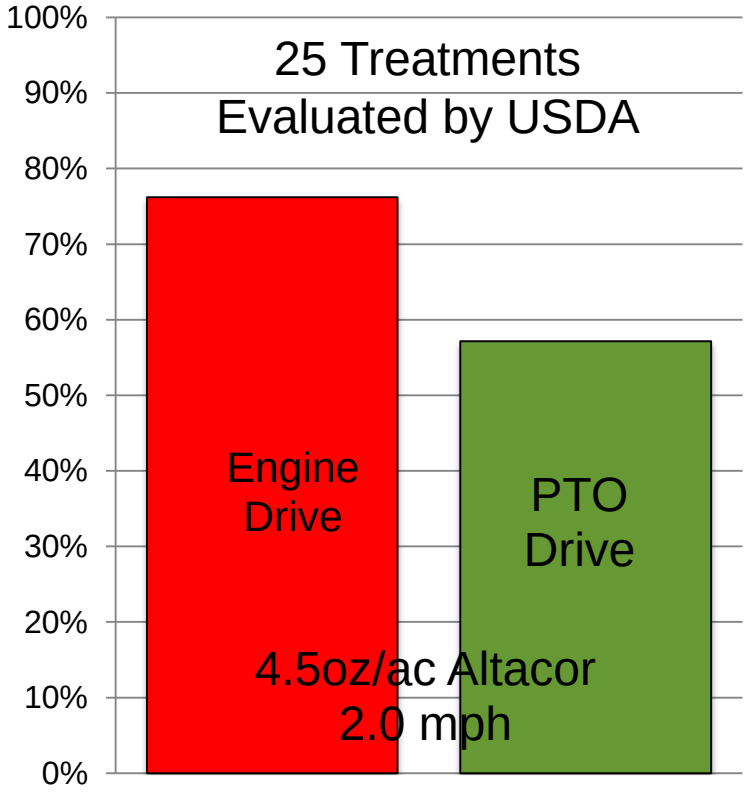
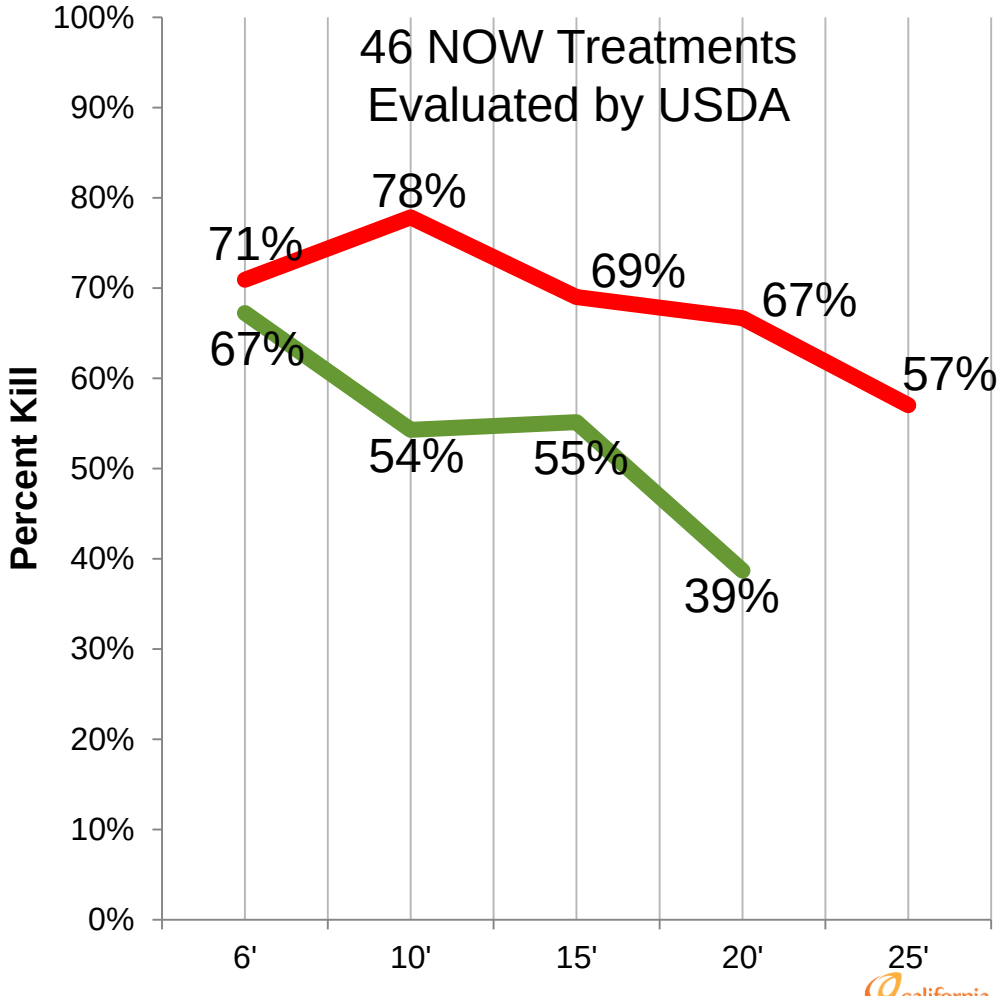
2014 Summary



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Thank you!
Matt Strmiska
Info@AgSprayHelp.com

Questions?

growing ADVANTAGE
The Almond Conference