



2018

THE ALMOND CONFERENCE

ALMOND ORCHARD 2025: REDUCING HARVEST
DUST

ROOM 308-309 | DECEMBER 6, 2018



AGENDA

- **Brian Wahlbrink**, Sperry Farms, moderator
- **Sheraz Gill**, San Joaquin Valley Pollution Control District
- **Sergio Capareda**, Texas A&M





water


harvest dust

**ALMOND
ORCHARD**

2025 GOALS

pest management

zero waste



REDUCE THE AMOUNT OF
WATER USED TO GROW A
POUND OF ALMONDS BY **20%**



REDUCE DUST DURING ALMOND
HARVEST BY **50%**



INCREASE ADOPTION OF
ENVIRONMENTALLY FRIENDLY
PEST MANAGEMENT TOOLS BY **25%**



ACHIEVE **ZERO WASTE**
IN OUR ORCHARDS BY PUTTING
EVERYTHING WE GROW TO
OPTIMAL USE



REDUCE **DUST** DURING ALMOND
HARVEST BY **50%**

Reducing Harvest Dust: Air Pollution Challenges in the San Joaquin Valley

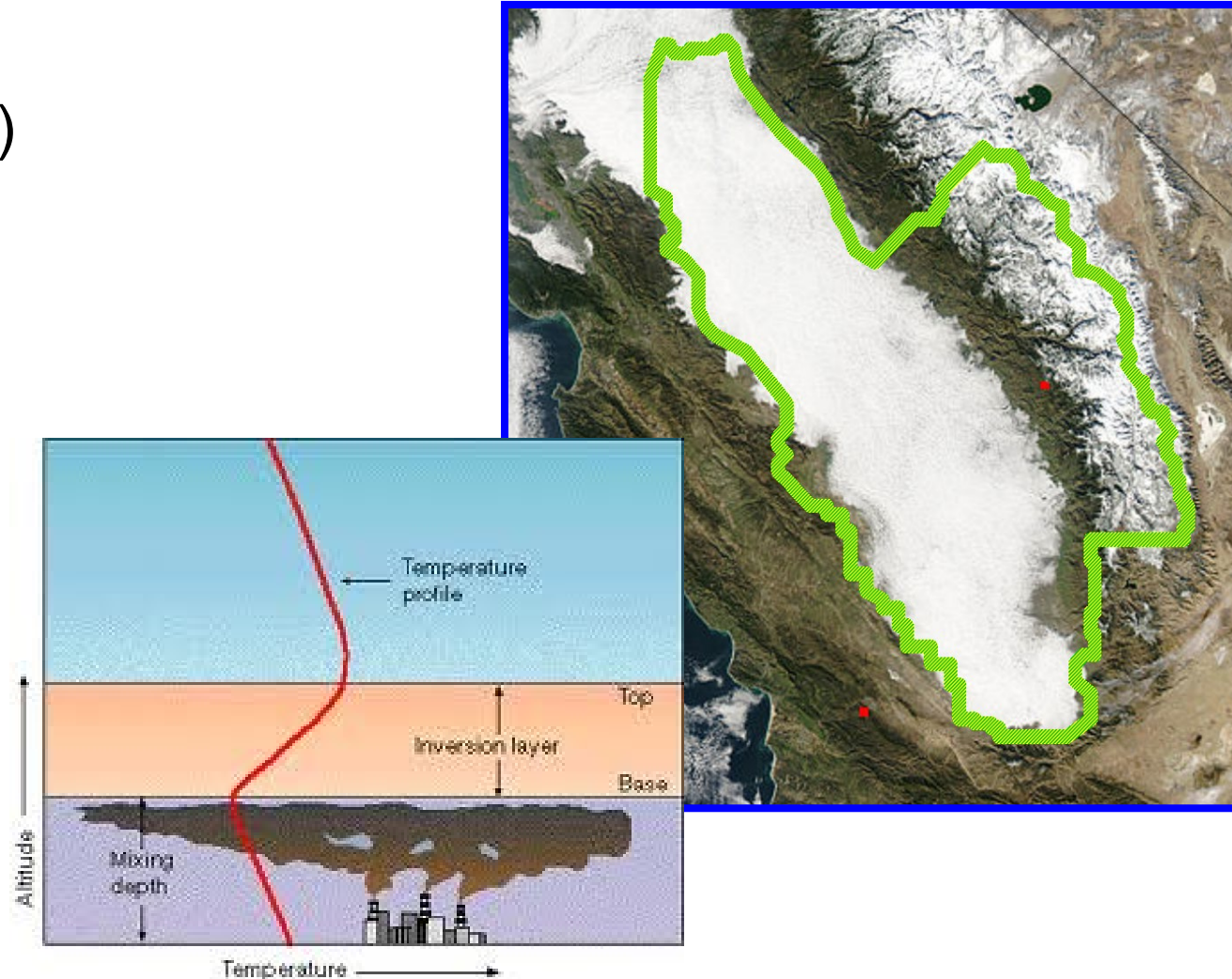
Sheraz Gill

**Deputy Air Pollution Control Officer
San Joaquin Valley Air Pollution Control District**

The Almond Conference
December 6, 2018

Valley Faces Unique Air Quality Challenges

- Valley made up of 8 Counties (San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, Kern)
- Surrounding mountains and meteorology help create and trap air pollution
- High poverty, unemployment
- High rate of population growth
- I-5 and Hwy 99 (major transportation arteries) run through Valley
- Summer challenge: Ozone
- Winter challenge: Fine Particulates

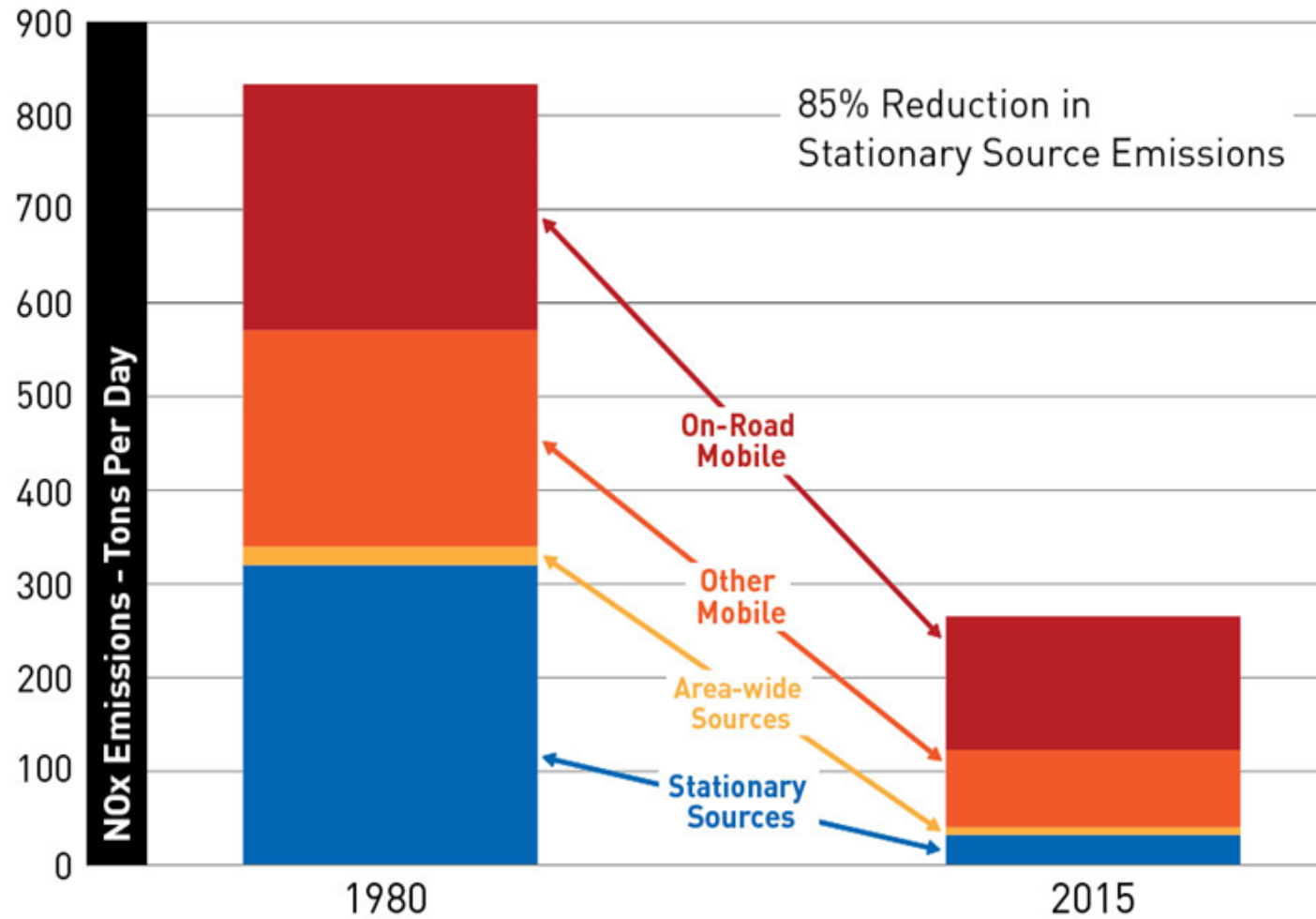


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Efforts to Improve Air Quality in the San Joaquin Valley

- The Valley Air District and CARB have adopted numerous attainment plans
 - Toughest stationary/mobile air regulations in the nation
 - Adopted over 600 stringent rules and regulations
 - 80% reduction in stationary source emissions
 - \$40 billion spent by businesses on clean air
 - Groundbreaking rules serve as model for others
- Effective incentive programs (over \$2.1 billion in public and private investment reducing over 145,000 tons of emissions)
- Public education and participation
 - Build public support for tough measures adopted
 - Urge air friendly behavior by public
- Clean air investments have significantly improved Valley's air quality
- Efforts by agricultural community helped Valley reach attainment of PM10

Major Reductions in Pollution



Federal PM2.5 Mandates

- Despite progress, Valley still faces challenges in meeting latest health-based standards established under the Clean Air Act
- District recently adopted a new attainment strategy to address multiple PM2.5 standards under the federal Clean Air Act
- 1997 PM2.5 Standard (24-hour 65 $\mu\text{g}/\text{m}^3$ and annual 15 $\mu\text{g}/\text{m}^3$)
 - Attainment deadline of 2020
- 2006 PM2.5 Standard (24-hour 35 $\mu\text{g}/\text{m}^3$)
 - Attainment deadline of 2024
- 2012 PM2.5 Standard (annual 12 $\mu\text{g}/\text{m}^3$)
 - Attainment deadline 2025



Harvest Dust Impacts

- Almond Harvest Emissions
 - 76% Pick-up, 13% Sweeping, 11% Shaking
- Significant increase in acreage devoted to nut crops in the San Joaquin Valley over past decade
 - Can generate highly visible and localized particulate emissions during harvest
 - Impact on neighboring communities, roads and nearby highways
- District receives significant number of fugitive dust complaints
- Need PM reductions in rural areas to reduce localized impacts on communities and nearby roads and highways

Efforts to Reduce Emissions from Nut Harvesting

- District regulates harvest emissions under the Conservation Management Practices program (Rule 4550) and nuisance regulation
- Almond Board of California, farmers, USDA-NRCS, and the District have partnered to develop best practices and new technologies for reducing dust during harvest
 - Sweeper height modifications, reducing the number of blower passes, reducing fan speeds, design changes to sweepers and pick-up equipment



Efforts to Reduce Emissions from Nut Harvesting (Cont'd)

- District has partnered with the Almond Board of California and other agricultural stakeholders to pursue several studies to evaluate the effectiveness of emerging low-dust technology
 - Studies have demonstrated low-dust technology can be effective at reducing localized particulates associated with harvesting activities
 - Most recent study (2017) indicates low-dust technology can reduce particulates by more than 40% and in some cases, up to nearly 80%
- Scientific survey concluded significant portion of growers and custom harvesters would be interested in low-dust equipment if provided with meaningful incentives
- District supported development of new USDA-NRCS program providing incentives to growers that utilize low-dust harvesting operations
 - NRCS program does not provide funding to growers for purchasing new equipment

Pilot Program Guidelines

- **Program Funding:** \$1,000,000
- **Funding Allocation:** First-come, first-served for each region of the Valley, based on submittal of complete applications
- **Eligible Entities:** Growers, custom harvesters
- **Eligible Equipment:** Low-dust harvesting equipment achieving at least 40% reduction in PM emissions as demonstrated by available peer-reviewed information and/or District-approved methodology including
 - Pull-behind Harvesters (pick-up)
 - Self-propelled harvesters (pick-up)
 - Shaker/Sweeper replacement technology
 - Non self-propelled (must be utilized in combination with tractor equipped with at least a tier 3 engine)
 - Harvester Incentives can be packaged with Tractor Replacement funding to upgrade tractor to tier 3 or cleaner engine if needed

Pilot Program Guidelines (cont'd)

- ***Engine Technology:***
 - Self-propelled: combustion engines must be the latest engine tier available
 - Pull-behind: tractor providing the motive power must be equipped with at least a tier 3 engine
- ***Incentive Amount:***
 - 50% of eligible equipment costs
 - Initially limited to 1 piece of new equipment per participant
- ***Old Equipment Disposition:***
 - Participants must agree to destroy or render existing old equipment permanently inoperable in accordance with established District criteria.
- ***Project Life:***
 - Participants must commit to utilize equipment for a minimum of five years/harvest seasons.
- ***Reporting/Inspections:***
 - Participants will be required to report on equipment usage, harvest information, and other relevant activity data throughout project life
 - District will inspect and document existing equipment, new equipment, and in-use activities at any time during project life to collect data on efficiency, PM emissions, and other relevant operating characteristics

Need more information? Want to apply for incentives?

- Pilot Incentive Program will launch on **December 17, 2018**
- On that date, further information and application forms will be available at: <http://valleyair.org/grants/>
- Interest in the program will be used to evaluate ongoing funding

Contact: Aaron Tarango

Mail: San Joaquin Valley APCD
1990 E. Gettysburg Ave
Fresno, CA 93726

Phone: (559) 230-5800

Email: Aaron.Tarango@valleyair.org

Other Incentive Programs for Agriculture

- Agricultural Tractor Replacement
 - Must be a Tier 0, 1 or 2
 - Must purchase a Tier 4f
- Agricultural Tractor Engine Repower
 - Must be a Tier 0, 1 or 2
 - Must purchase a Tier 4
- Agricultural Tractor Trade-Up
 - Beneficiary must have a Tier 0 or 2
 - Awardee must have a tier 3 and go to a tier 4f
- Agricultural Irrigation Pump Repower
 - Tier 3 to Tier 4f
 - Tier 3 or 4i to electric w/line extension
- Agricultural Truck Replacement
 - Incentive is 65% of the purchase price

Other Incentive Programs for Agriculture (cont'd)

- Agricultural UTV Replacement
 - Gas or Diesel to Electric
- Agricultural waste soil incorporation (coming soon)
 - District will provide funding for the chipping of agricultural material and the reuse of this material on-field through soil incorporation, land application of mulch, or other approved on-field practices
- Electrified Dairy Feed Mixer Program
 - Elimination of existing ag tractors that mix and deliver feed,
 - Elimination or reduction in usage of on-road trucks used to deliver feed, and
 - Reduction in usage of any remaining off-road equipment used in the feeding process

Grant Resources

District Grants Webpage

grants@valleyair.org

Phone: (559) 230-5800

Email: grants@valleyair.org

Almond Orchard 2025: Reducing Harvest Dust



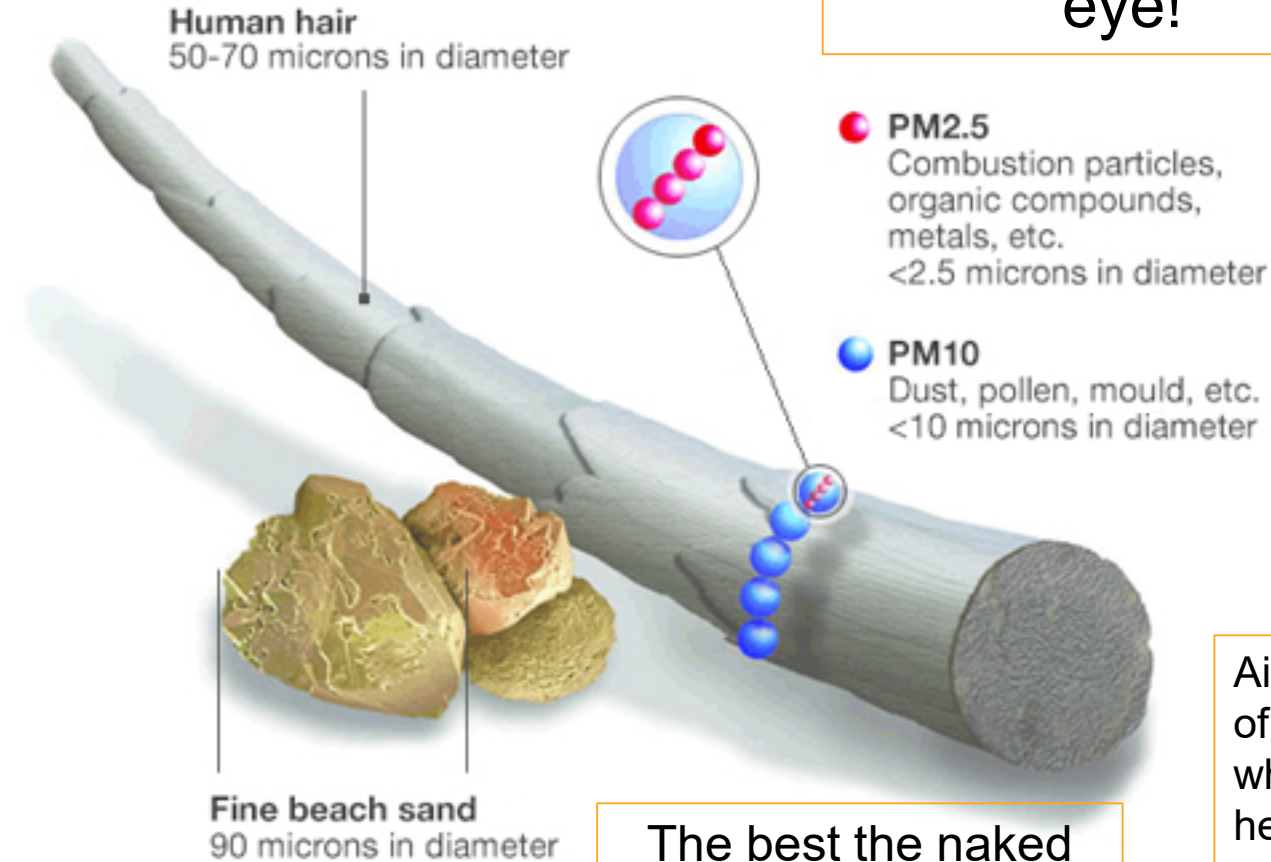
Sergio C. Capareda, PhD, PE, Faculty Fellow
Biological and Agricultural Engineering Department (BAEN)
College of Agriculture and Life Sciences (COALS)
Texas A&M University, College Station, TX



Learning Objectives

1. Understanding why industry must reduce particulate matter (PM) emissions during harvest, particularly PM_{2.5}, PM₁₀, Total Suspended Particulates (TSP) or visible dust
2. Review of the National Ambient Air Quality Standards (NAAQS) and focusing on dust (both non-visible and visible) and what are dust types.
3. Enumerate the process of establishing emission factors (EFs) using Federal Reference Method (FRM) Samplers for PMs and Dispersion Modeling and difficulty in analysis and reporting
4. Describe the history of establishment of emission factors for almond harvest operations and research and equipment used in the past
5. Compare almond orchard dust generation with other agricultural practices
6. Summarize the best management practices recommended
7. Describe the current status of dust accumulation by the industry
 - Primary Goal: How to Reduce Harvest Dust

Particulate Matter



Both PM₁₀ and PM_{2.5} cannot be seen by the naked eye!

To Set Things Straight:
Agriculture is not the leading cause of problematic air emissions but almond growers and handlers can mitigate the problem by reducing their own **CONTRIBUTIONS!**

Our thoracic body parts can filter out some PM₁₀, but PM_{2.5} goes straight to our lungs and in blood streams!

Air pollution is the presence in the outdoor atmosphere of any one or more substances or pollutants in quantities which are or may be harmful or injurious to human health or welfare, animal or plant life, or property or unreasonably interfere with the enjoyment of life or property, including outdoor recreation. FL Admin Code.

The best the naked eye could see is around 40 µm!

Source: US EPA

The National Ambient Air Quality Standards (NAAQS)

Pollutant	Level	Averaging Time
Carbon Monoxide (CO)	9 ppm (10 mg/m ³) 35 ppm (40 mg/m ³)	8 hours ^a 1 hour ^a
Nitrogen Dioxide (NO ₂)	0.053 ppm (100 µg/m ³) 0.100 ppm	Annual Arithmetic Mean 1 hr ^b
Ozone	0.075 ppm	8 hours ^c
Sulfur Dioxide	0.03 ppm 0.14 ppm 0.50 ppm	Annual Arithmetic Mean 24 hours ^a 3 hours (secondary std)
Particulate Matter (PM ₁₀)	150 µg/m ³	24 hours ^d
Particulate Matter (PM _{2.5})	15.0 µg/m ³ (CARB, 12 µg/m ³) 35 µg/m ³	Annual Arithmetic Mean ^e 24 hours ^d
Lead	0.15 µg/m ³	3-month rolling average

Emission Factors of Other Agricultural Operations

Commodity	Emission Factor	Compared to Almond	Data Source Basis
Rice	1.68	0.054x	Cotton
Corn	1.68	0.054x	Cotton
Barley	5.80	5.4x	Wheat
Alfalfa	5.80	5.4x	Wheat
Peanuts	1.68	0.054x	Cotton
Pecans	3.12	0.10x	Almond
Walnuts	31.2	1.0x	Almond
Pistachio	3.12	10x	Almond
Chestnuts	3.12	10x	Almond
Macadamia	3.12	10x	Almond

The highest harvest emission factor comes from almond harvesting followed by wheat and cotton, where most other EFs were based. All others less than 1.

Most emission factors from other agricultural commodities comes from the almond emission factors!

Review of Emission Factors for Almond Harvesting Operations and Other Crops

PM ₁₀ Emission Factor	Old (2003-2012)	Old (2003-2012)	Newer EF (2012)	Newer EF (2012)
Operation	lbs/acre	kg/hectare	lb PM ₁₀ /acre/yr	kg PM ₁₀ /km ² /yr
Shaking	0.37	0.415	3.47	390
Sweeping	3.7	4.15	4.15	466
Harvest	36.7	41.2	23.60	2,650
Total	40.8	45.8	31.2	3,506 (vs 4,580)

Agricultural Operation	lb PM ₁₀ /acre/yr	vs Almond
Cotton Harvesting	3.4	9.2x
Wheat Harvesting	5.8	5.4x

Almond Industry Concerns

- EPA Regulations continue to become stringent
- NAAQS will be updated continually
- State Implementation Plan (SIP) continually updated and more stringent than national values
- Nuisance
- Nuisance
- Nuisance

A case of grain drying activity in Iowa held to be a nuisance and asked to pay \$190,000 in damages!

“Over the years, the Iowa courts have dealt with many nuisance cases both in an agricultural and non-agricultural context. Two points are clear from the rulings – one landowner cannot unreasonably interfere with another landowner's use and enjoyment of their property; and negligence is not the same thing as nuisance.

On the latter point, it doesn't matter if a landowner has obtained all of the necessary permits, is conducting their activity in accordance with best management practices and is in compliance with all applicable zoning rules - the activity can still be deemed to be a nuisance.

This case is the latest installment in that long line of nuisance litigation. *Miller, et al. v. Rohling*, 720 N.W.2d 562 (Iowa Sup. Ct. 2006).

Agricultural industry is receiving more nuisance complaints from citizens!

What Can We Do to Lower Harvest Dust?

- There are numerous ways to lower harvest dust.

Various Ways to Help Reduce Dust Formation During Harvest

- Proper Orchard Floor Management (clean, smooth floor, no grasses, level orchard, good crown, clean pile)
- Reducing Particulates by Paved Surfaces (speed limits, water/oil application, pave old roads, trees traps)
- Reducing Particulates During Harvest Operations (proper machine adjustments, newer machines)
 - Shaking, sweeping and pick-up operations (limit sweeping passes, catch nuts before returning to windrows)
 - Invest on newer harvest machines and improve operation of old machines
- Hulling and Shelling (paved facilities, routine inspections, dust control facilities, proper designs)
- Combustion Particulates
 - Avoid burning pruned plant parts
 - Install newer engines and pumps
- Invest on new varieties that will require only one pass-harvest

Catch-frame Comparison



1015 $\mu\text{g}/\text{m}^3$



700 $\mu\text{g}/\text{m}^3$

Average net PM_{10} concentrations measured during pick-up

Sampling Techniques Used in the Past

- Gravimetric high volume samplers and low volume samplers
- LIDAR (Light Detection and Ranging)
- Particulate matter samplers on towers



EPA requires the use of dispersion modeling to establish emission factors (EFs).

Early 2000s: ISCST3

Present: AERMOD

Research on Dust Reductions Over the Years

- Reduced Pass (2009)
 - Emissions reduction of 49%
- Lower Fan Speeds (2011)
 - 3X reductions
- Proper Sweeping Depth (2012)
 - 70% reduction in emissions
- Improved Machinery Part 1 (Faulkner, 2013)
 - 61% reduction in PM_{2.5} Emission Factor

2017 Harvest Studies

- Use of FRM PM_{2.5} and PM₁₀ Samplers
- 4 Major Machinery Manufacturers
- Harvesting Efficiencies Evaluated
- Constant Forward Speed (3 mph) and Blower RPM for all Machines
- Use of Dispersion Modeling for Emission Factor Calculations (AERMOD)
- Use of GPS for Machine Movement and Speed (Use of Moving Line Source)

If goal is comparable to other agricultural harvest operations, then emission factors reductions must be between 5 -9x lower (500% to 900% reductions).

Simple Quick Methods Evaluated this Year (2018)

- EPA Method 9 or Visual Emissions Evaluation (Requires Certification) Certification procedure is free.
- EPA Alternative Method 082 or also called Certified Digital Camera Opacity Techniques (DCOTs) or Digital Opacity Compliance System Second Generation (DOCS II) (c/o Shawn.Dolan@virtualllc.com). This can be used in lieu of EPA Method 9 for all subparts of 40 CFR 60, 61 and 63. Matches ASTM D7520 Standards for stationary, mobile and fugitive dusts evaluation. (Requires Certification)
- Use of opacity meters
- Use of portable laser particulate matter sampler (e.g. AEROCET 831 by MetOne) attached to drones



Comparison of Compliance Methods

EPA Method 9

- (1) set of (25) White and (25) Black (50 readings)
 - EPA Required Content Training
 - 50 plume certification
 - $\pm 7.5\%$ overall and $\leq 15\%$ within each set of 25
- Certificate duration is 6 months
- Operational Conditions
- Paper Non-Validated Record

EPA Alt 082 “Electronic Method 9” allows separation of data “capture” from “analysis”.

EPA Alt 082

- (6) sets of (25) White and (25) Black against various backgrounds (300 images)
 - 4 independent analyst use system to derive Opacity of each image (1,200 results)
 - All (4) analyst must pass all (6) sets, + 7.5% overall and $<15\%$ within each set of 25
- Certification duration 3 ½ years
 - EPA required content training
 - DCOT-specific training
 - Training for life (must submit 1 acceptable image for analysis semi-annually, VTLLC company rule)
- Operational Conditions
 - Unlimited backgrounds
 - Unlimited weather conditions
- Digital Validated record

DOCS Procedure

Send for Analysis

Capture

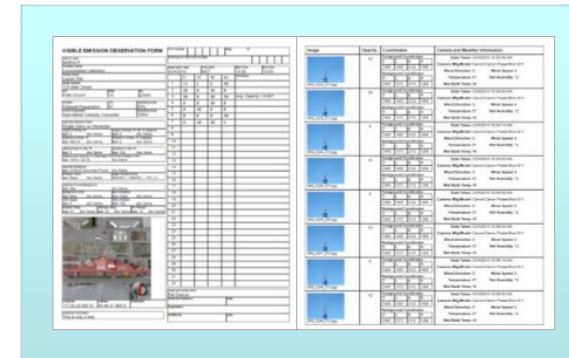
Use of Digital Camera or Video Camera



Transfer images automatically or manually



Receive Validated Digital Report



Insert Video Here

Conclusion

- The Almond Board of California has been conducting dust emission studies for about 2 decades
- All almond dust harvest studies follow EPA and CARB suggested experimental protocol, analysis and reporting
- Best management strategies to lower dust emissions has been in place in all aspect of almond nuts production and processing
- Industry now has access to quick methods of visible dust evaluations
- We are establishing the current baseline visible dust concentrations based on visible dusts or total suspended particulates (TSP) concentrations.
- We will outline ways to reduce dust in preparation for the next harvest season.
- Plan will be a combination of years of research experiences including new innovative ways
- All almond harvest machinery models qualify for NRCS-EQIP incentives. Industry must take advantage of these incentive programs.

Thank you!



Harvest Dust- You Can Make A Difference

A caller told ABC this fall: “This year she’s seen significant changes and very little dust thanks to a water truck that the grower is using around the orchard’s perimeter and the sweeper operators turning off their blowers/using slow speeds when they make turns at the end of the row.”

Making air cleaner is dusty work, worth it

In the Central Valley, almond harvest means different things to all of us. For almond farmers like me, it’s the busiest time of year as we shake, sweep and pick up the crop we have cultivated all year. My team comes together in the orchards and we’re able to see the results of all our hard work.

However, for many valley residents, harvest also means dust.

The increase of dust particles in the air during harvest time is an issue, drifting over backyards, blanketing cars and settling in swimming pools. It can also block drivers’ ability to see when driving past an orchard, making signs that read “Caution, low visibility – dusty area ahead” a common sight on Central Valley roads.



BY BRIAN WAHLBRINK

We farmers understand dust can be a nuisance, so we’re doing something about it.

Over the past decade, the Almond Board of California has invested in research to develop practices that can reduce dust and the associated issues that come with it during harvest. Many of these practices are being implemented in orchards up and down the Central Valley.

In 2015, the research was transformed into an educational campaign for farmers,

distributing information on reducing dust through a series of videos, technical guides, orchard workshops and equipment demonstrations.

But there is more to be done.

Last year, I jumped at the opportunity to lead the newly formed Harvest Workgroup, a collection of almond farmers, processors, advisers and equipment manufacturers brought together by the Almond Board of California. Our mission is to improve air quality during harvest by guiding research and taking a progressive, forward-thinking approach to the issue through innovation.

What we’re really doing is trying to imagine the almond orchard of the future.

The research we’re doing will accelerate efforts we

believe will result in cleaner air for all who live in the Valley.

Some of the areas we’re exploring include changing the structure and layout of our orchards to implement harvest techniques similar to pistachios or grapes. We are doing our due diligence to ensure these changes can have both a positive environmental impact and be viable for farmers, something that takes time.

Outside of the working group, some farmers are running experiments of their own.

Earlier this month, I invited equipment manufacturers out to my farm to run side-by-side tests of dust and debris production using three very different pieces of machinery. Running trials like this in the middle of the busy harvest

season can make things even more chaotic and requires sacrificing some of the crop, but it is absolutely worth the effort and cost.

Over 90 percent of those in our industry are family farmers; we live, work and raise our families on the land. So we all have a vested interest

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The Record RECORDNET.COM

Almond harvest will be kicking up dust — but it shouldn’t affect air



“The California Almond Board encourages growers to invest in new harvesting equipment and follow practices that keep dust to a minimum. Videos on the board’s website offer tips on dust reduction for each phase of the harvest.”