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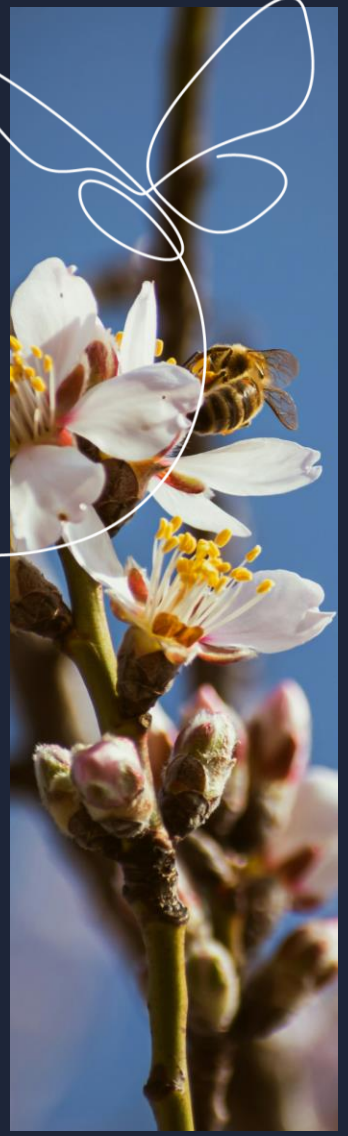

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Post-Harvest Pest Management

December 11, 2024

ALMOND BOARD OF CALIFORNIA

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Managing Insects in Harvested Nuts

Moderator: Gabriele Ludwig (ABC)

Speakers: Abhi Kulkarni (ABC), Eric Myers (ADM), Zhongli Pan (UC Davis), Spencer Walse (USDA ARS)

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Managing Insects in Harvested Nuts

Speakers: Abhi Kulkarni (ABC)

Ship It & Forget It?

01 Growing

02 Harvesting

03 Packing

04 Shipping

05 Done?

Buyers Getting More Than They Paid For…

Buyer Frustration

Good Day Abhijeet

Trust you are well and had a safe journey back to California

You met a colleague of mine a couple of weeks ago in London at a trade convention where Lewis was part of several members of the NDFTA who were there to discuss infestation (mainly live beetle) in containers of Almond deliveries to the UK.

This week alone we have received two containers, both infested, one from [redacted] and the other from [redacted]

Three years ago, I made a journey to California and visited various suppliers, all had very little interest in talking about the issue of infestation in Almonds, almost an arrogance towards it not being an issue!

We are a retailer packer (bagger) for several large supermarkets, if any of packets get to retail with live infestation, we face the issue of a minimum product recall of $150,000 and a major black mark on our reputation

Communication Matters!

california almonds
Almond Board of California

MANAGING INFESTATION

A Guide to Product Handling Practices Upon Receiving to Minimize Infestation

RECEIVING

Containers should be picked up from the port at the earliest opportunity (< 10 days) upon arrival.

Why is this important?

Prolonged exposure to higher temperatures and humidity will provide conducive environment for insect growth and develop other quality issues.

PARTNERSHIP

Managing storage insect pests is a joint responsibility.

Why is this important?

Storage food pests are a threat throughout the supply chain. California almond shippers will do their part in controlling this threat prior to shipping. But buyers have an equally important role to play to minimize infestation risks with proper management of product storage areas.

STORAGE/HANDLING

Inspect the stored product areas to detect any infestation issues and take appropriate action.

Why is this important?

Almonds are a natural food product and need to be managed carefully just like any other stored food to prevent insect growth and infestation in storage.

California shippers monitor/treat the storage areas and/or the products to limit insect growth using various pest management tools. **A similar strategy at the customer warehouse would be beneficial.**

REMEMBER: "Store it and forget it" is not an optimum product management policy.

INSPECTION

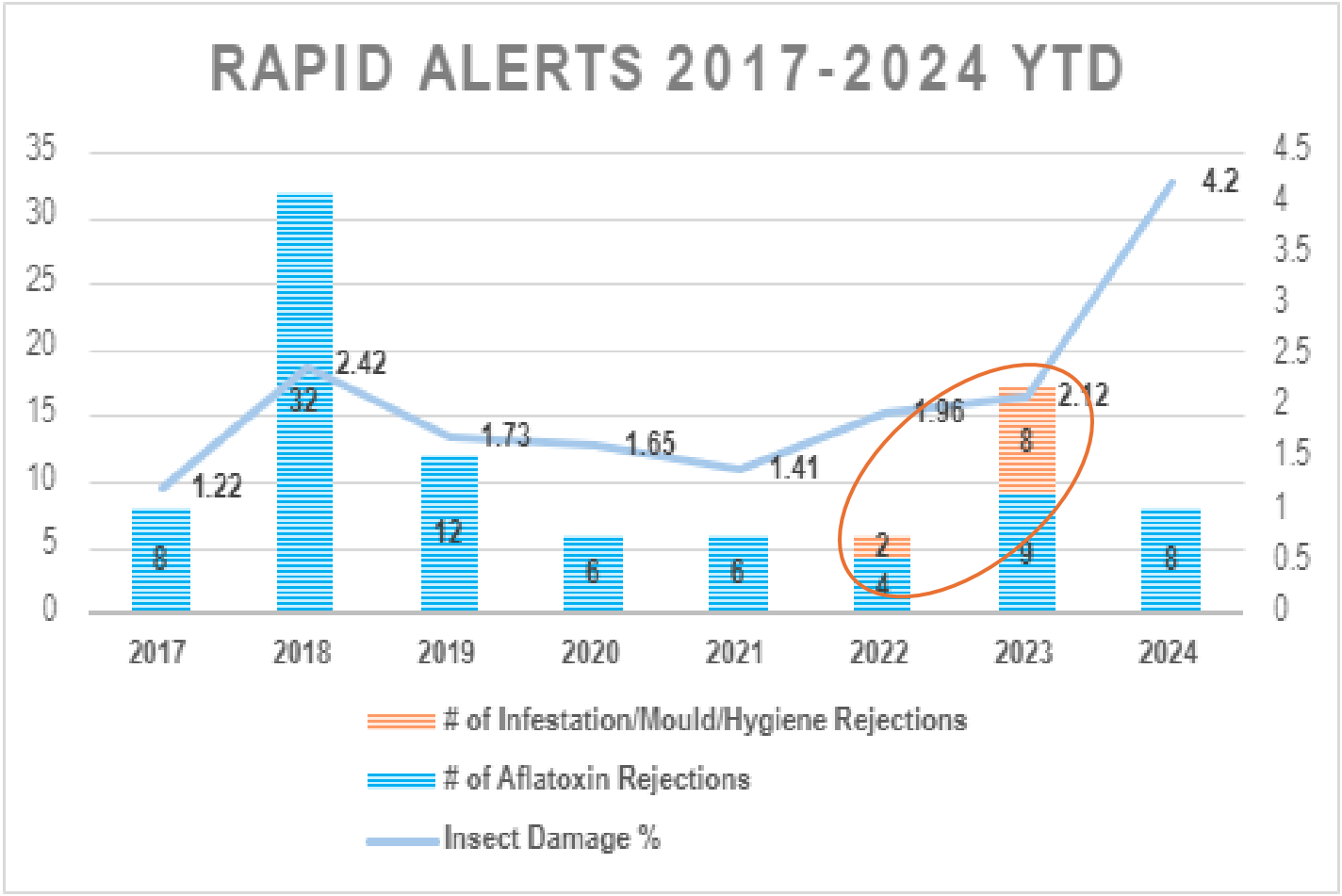
Inspect the shipment for any quality issues and notify the shipper if any issues are noted.

Why is this important?

Inspection upon taking possession of the shipment (2-3 days) provides an accurate assessment of the product.

The longer you wait to inspect the shipment, the more influence local storage conditions have on the shipment quality.

Rapid Alerts in the EU

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Managing Insects in Harvested Nuts

Speakers: Eric Myers (ADM)

Using IPM to Solve Problems

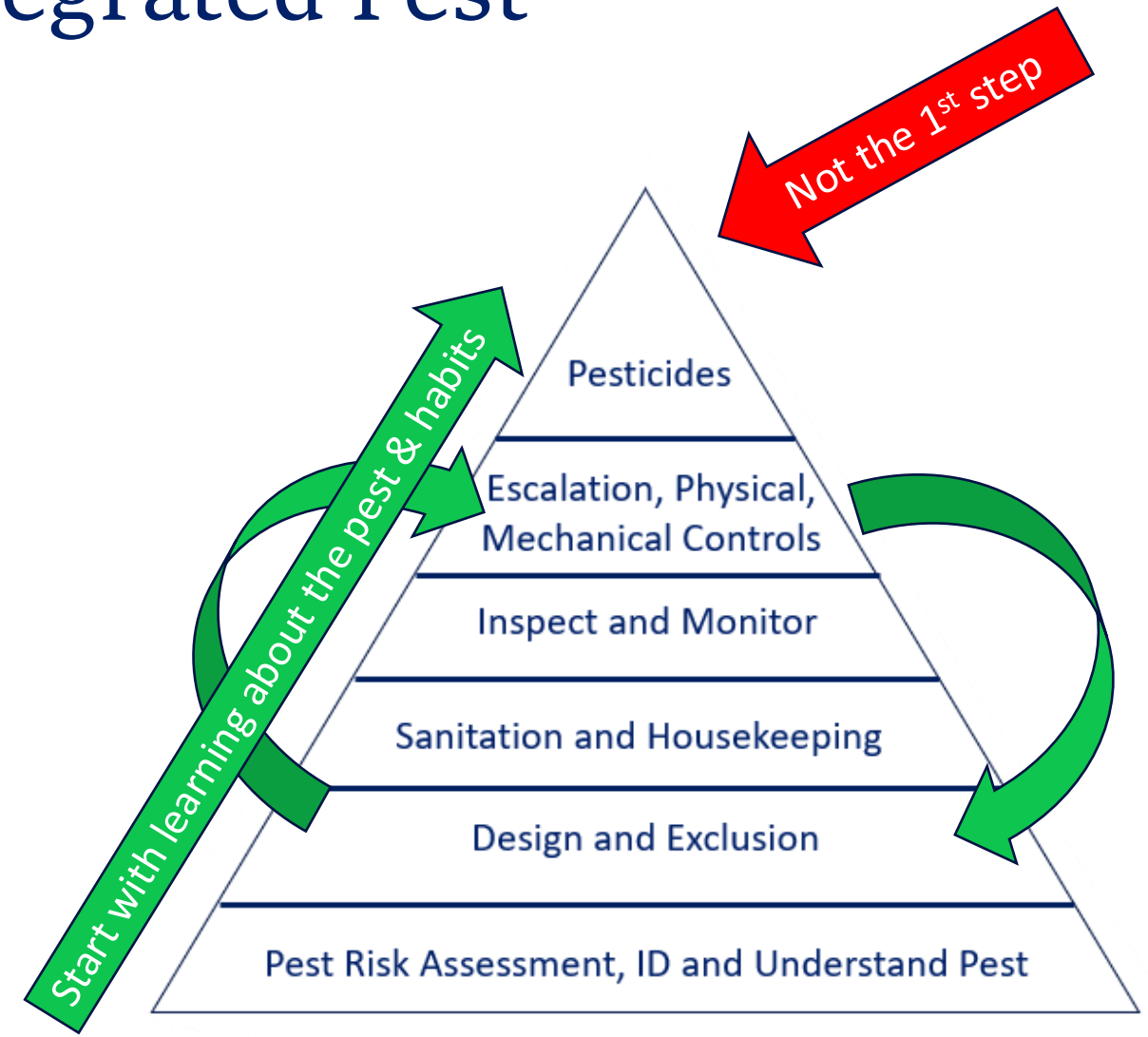
1. **Mindset** (motivation) Matters
2. The **Type** of **Pest** Matters
3. The **Site** and Manufacturing **Process** Matter

Presented by: Eric Myers, ACE – Global IPM Manager

Mindset Matters - Why Integrated Pest Management (IPM)

What motivates you?

- Is **IPM** just a buzz word
- Almonds will **always** have bugs
- **Brand** Protection
- Audits
- Customer **Complaints**
- **Reliance** on fumigation is the **status quo**



Mindset Matters – What is IPM?

- IPM focuses on **long-term prevention** of **pests** or their **damage** by managing the ecosystem
- With IPM, **you take actions** to keep pests **from becoming** a problem, such as by growing a healthy crop that can withstand pest attacks, using disease-resistant plants, or **caulking cracks** to keep insects or rodents from **entering a building.**
- Rather than simply eliminating the pests you see right now, using IPM means you'll look at **environmental** factors that **affect the pest** and its **ability** to thrive. Armed with this information, you can create **conditions** that are **unfavorable** for the pest.

The Type of Pest Matters

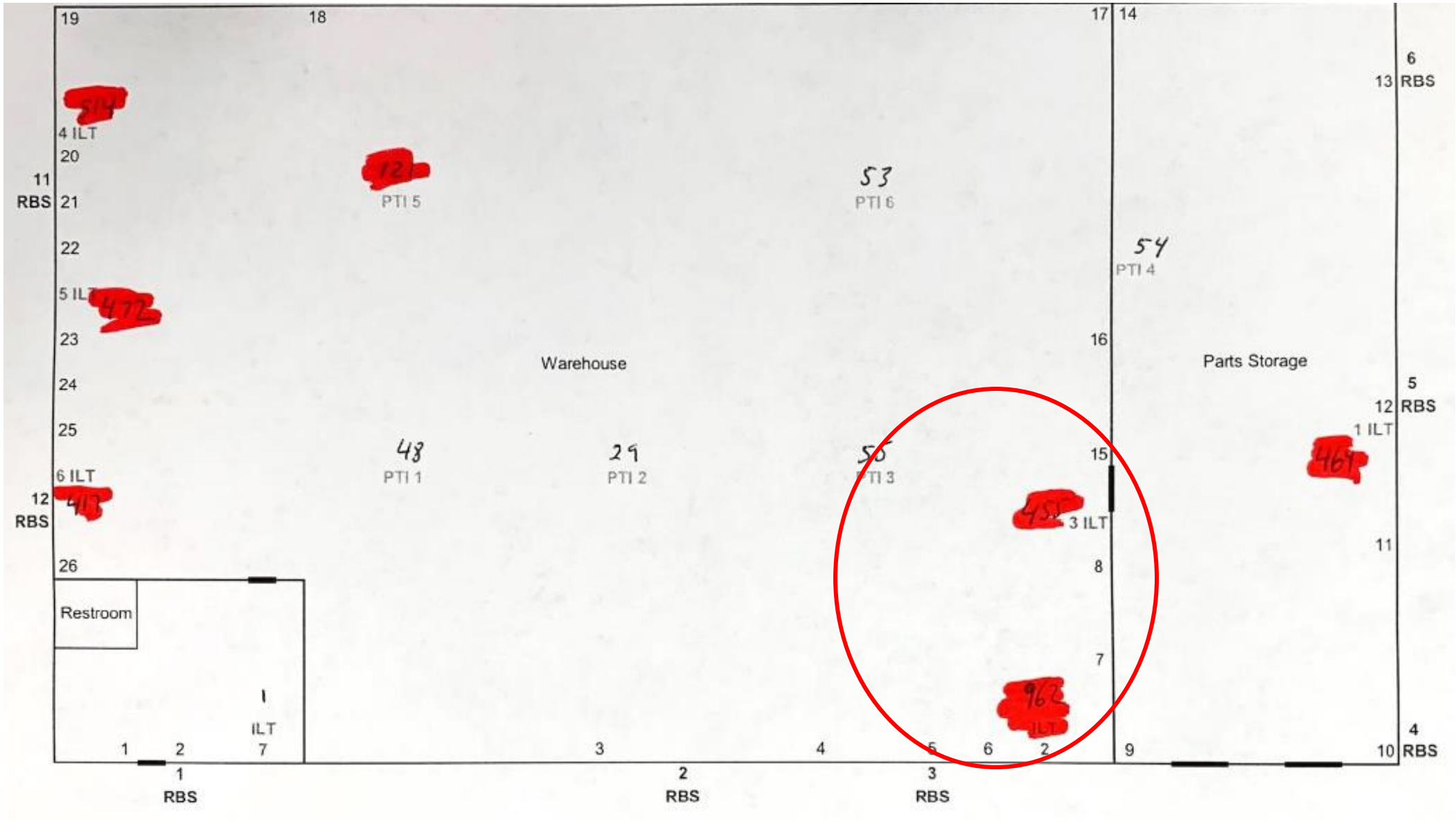
Insect **Presence** is the **Effect**, NOT the cause

- Pest Presence
  - **IS EVIDENCE** of a condition
  - Doesn't belong
  - In **abundance** beyond accepted **tolerances**
- **Predictable** Pest risk
  - **Expected** based on a type of facility, its surroundings, and/ or a **commodity**, **ingredient**, or **finished product** that is handled, stored, produced or packaged
  - **Inherent** or Subject to **Certain** pests
- Vulnerability
  - Every site is **vulnerable** to pest **access**
  - **Incoming** goods/ materials

The Type of Pest Matters

- Feeding patterns associated with insects infesting stored products
  - **Commodity** Feeders – Most notable & focused group
    - **Primary** Pests – feeds on **whole** grains and lays eggs inside the commodity
    - **Secondary** Pests – feed on **damaged** and **processed** commodities
- Insect **Life Stages**
  - Mobile (adults & larva)
    - **Easy** to see
    - Larva **indicate** close(r) to a **source**?
  - Immobile (egg and pupa)
    - The **target** life stages
    - Need to be thinking **Hidden** & **Protected**
  - What **causes** the damage
  - **Where** does the insect **pupate**

So How do I Find all these areas?

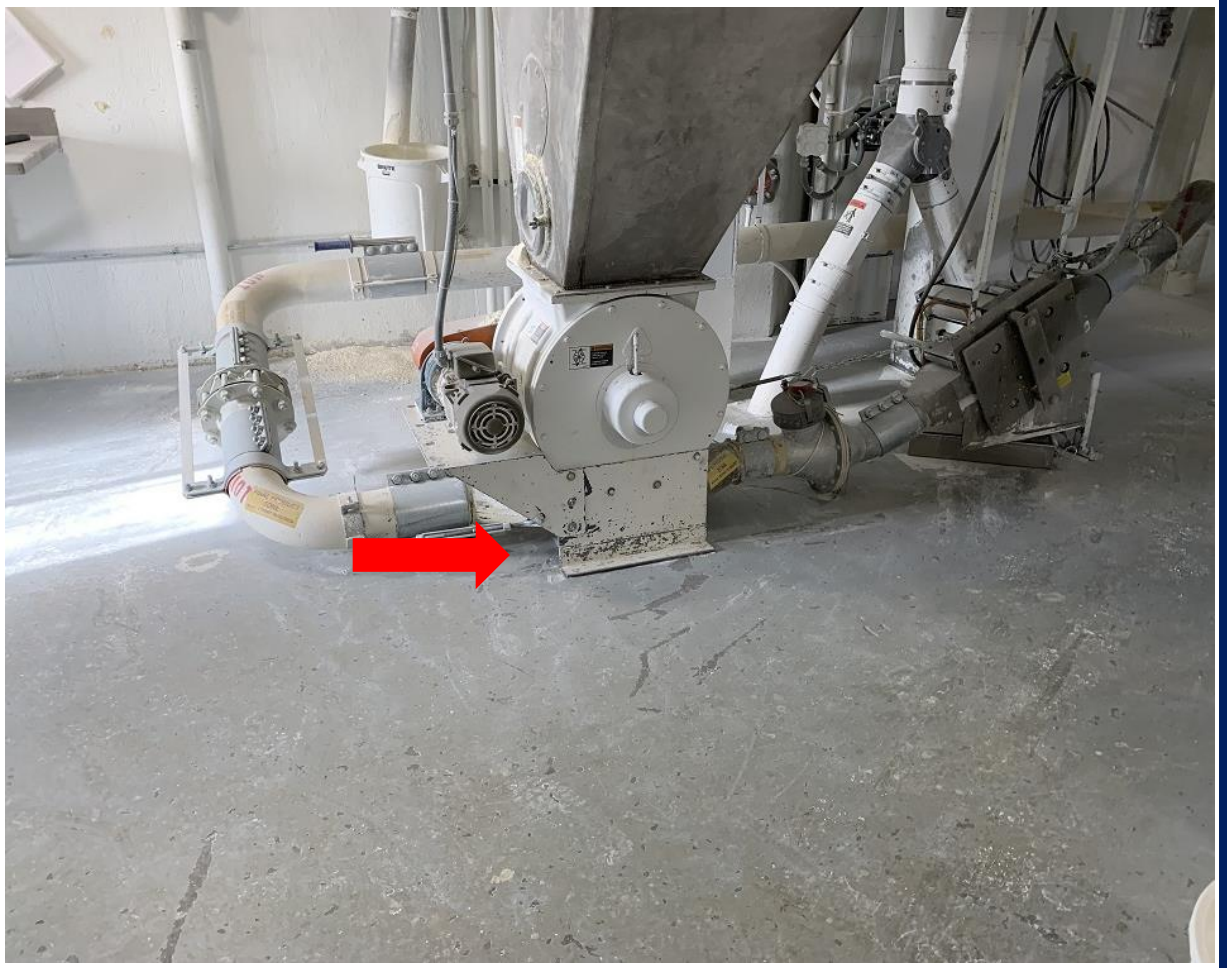


How do I find these areas

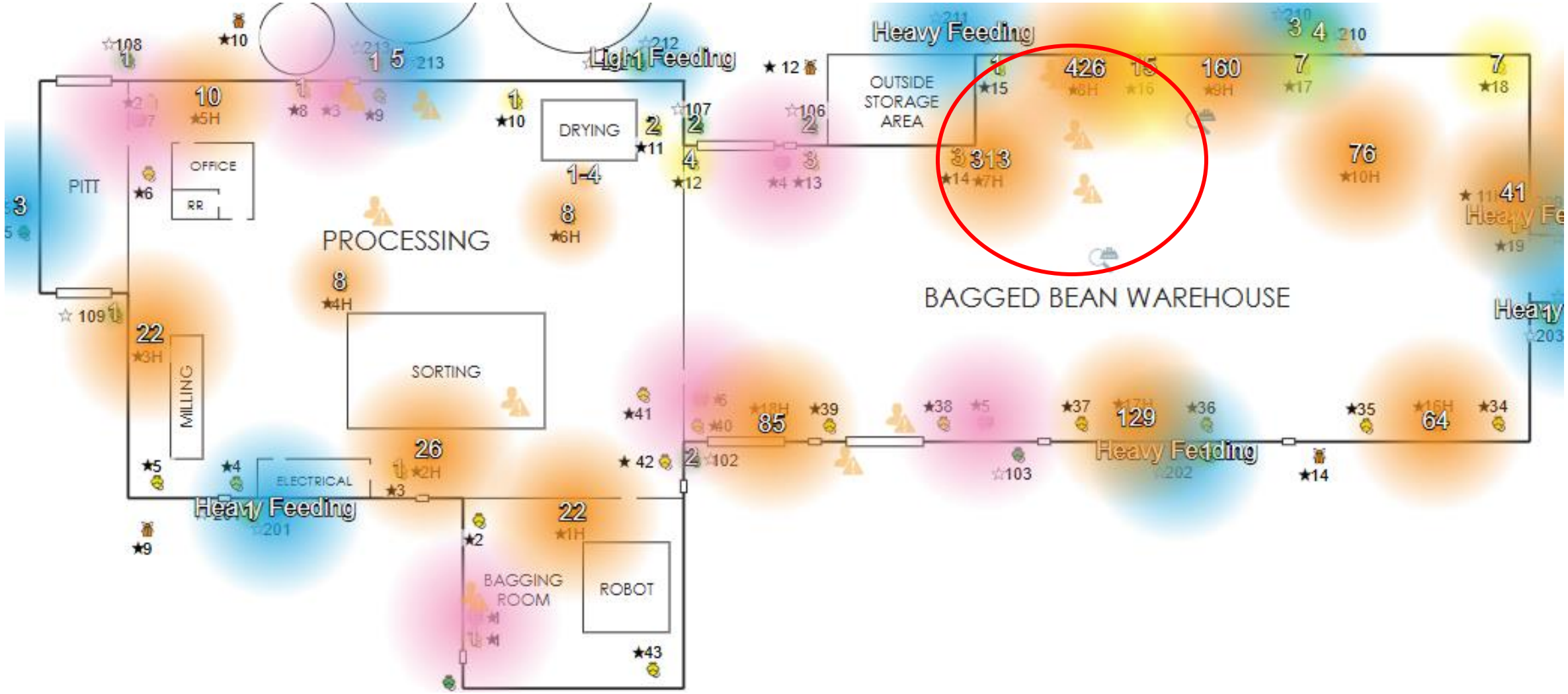
- Why **here**?
  - What **condition** is present or exists
  - Remember pest **biology & habits**
  - Where is the Food, **Shelter** and/or **Opportunity**
  - What hasn't been disturbed (**look high, look low**)
  - What hasn't been accessed recently (**look up, go up**)
- **Learn** and understand the **process** (be **curious**)
  - Different **vulnerable**/ **risk** stages of the process
  - Where/ when is the **opportunity** for the insects
  - It's **not** all about the commodity…

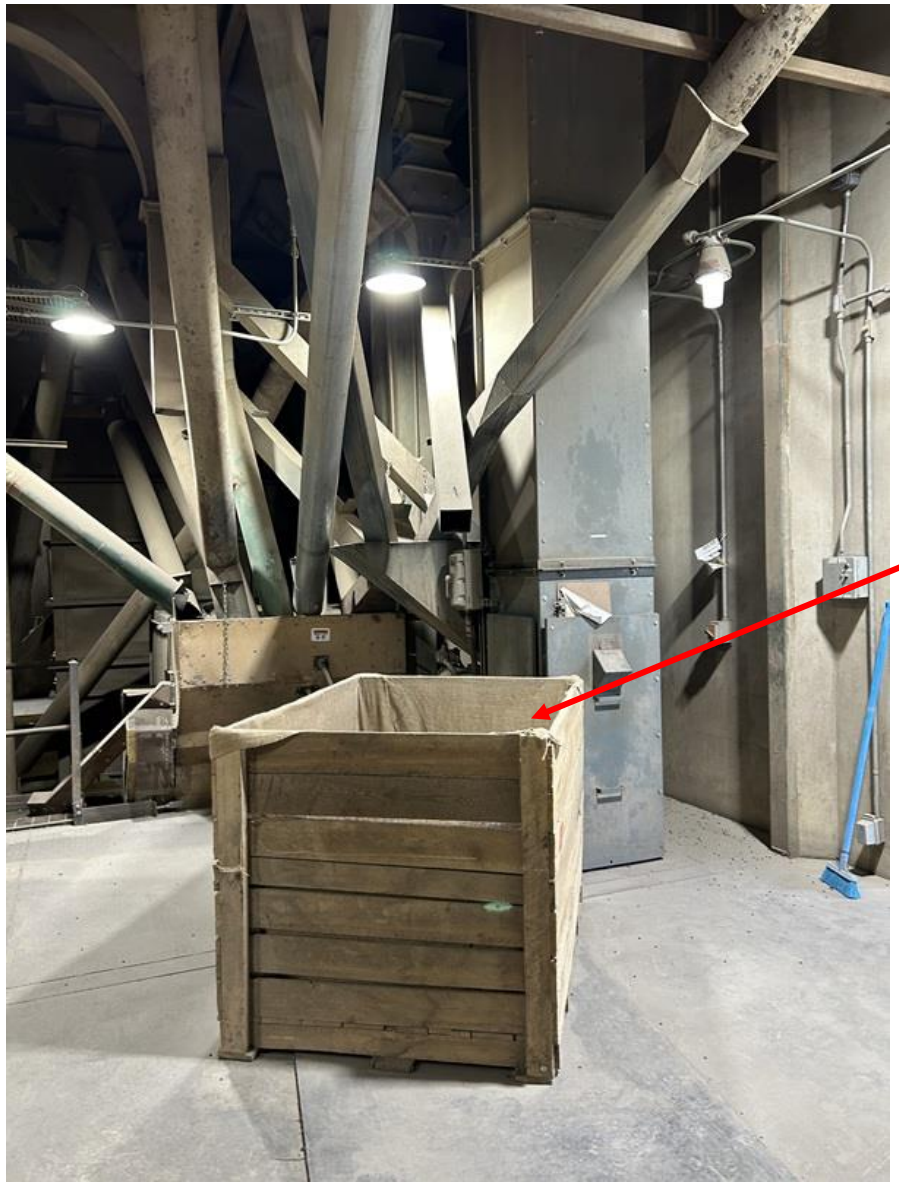
How do I find these Issues?

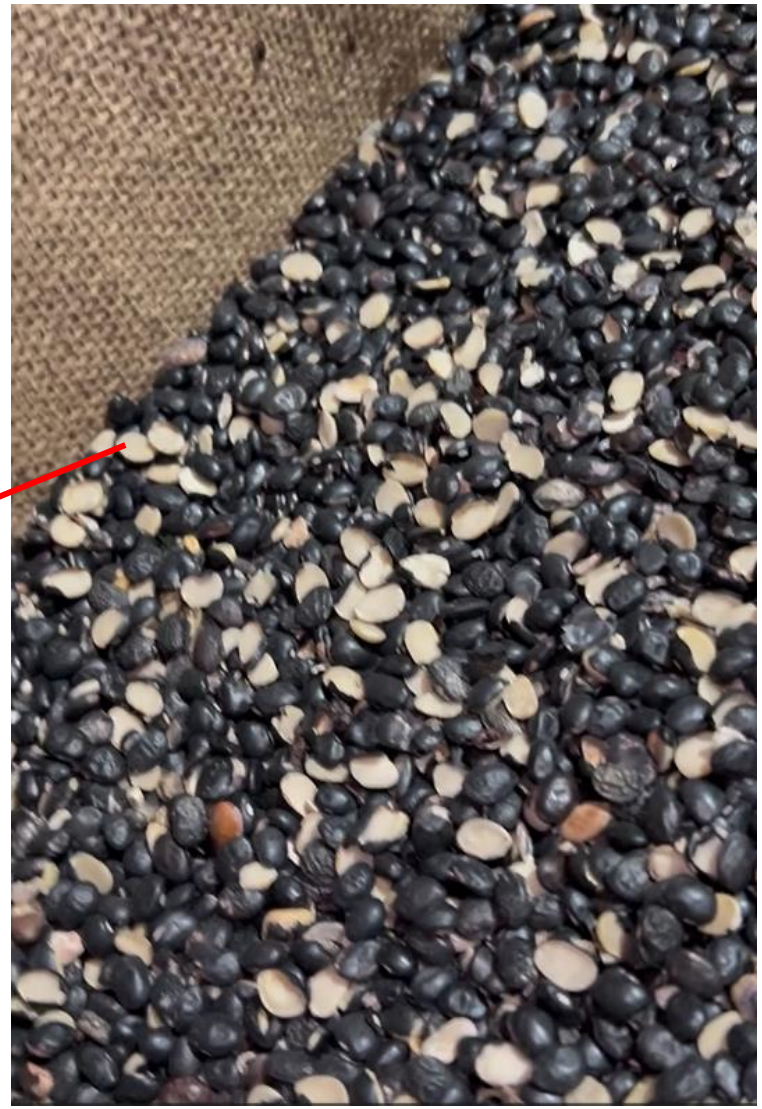
- My “red flag” areas
  - Idle Equipment
  - Dead zones (inside equipment)
  - Dead zones (within the structure)
  - Infrequently accessed areas (overheads, platforms)
- Conditions to be looking for (remember immobile life stages)
  - Missed cleaning opportunities
  - Hidden product accumulation
  - Type/ processing stage of spillage (proximity of by-products)
  - Aged product (in equipment or in packaging)
  - High temps/ humidity
  - Outside or other support areas (loadouts, scales, etc.)?



It’s Repeatable…

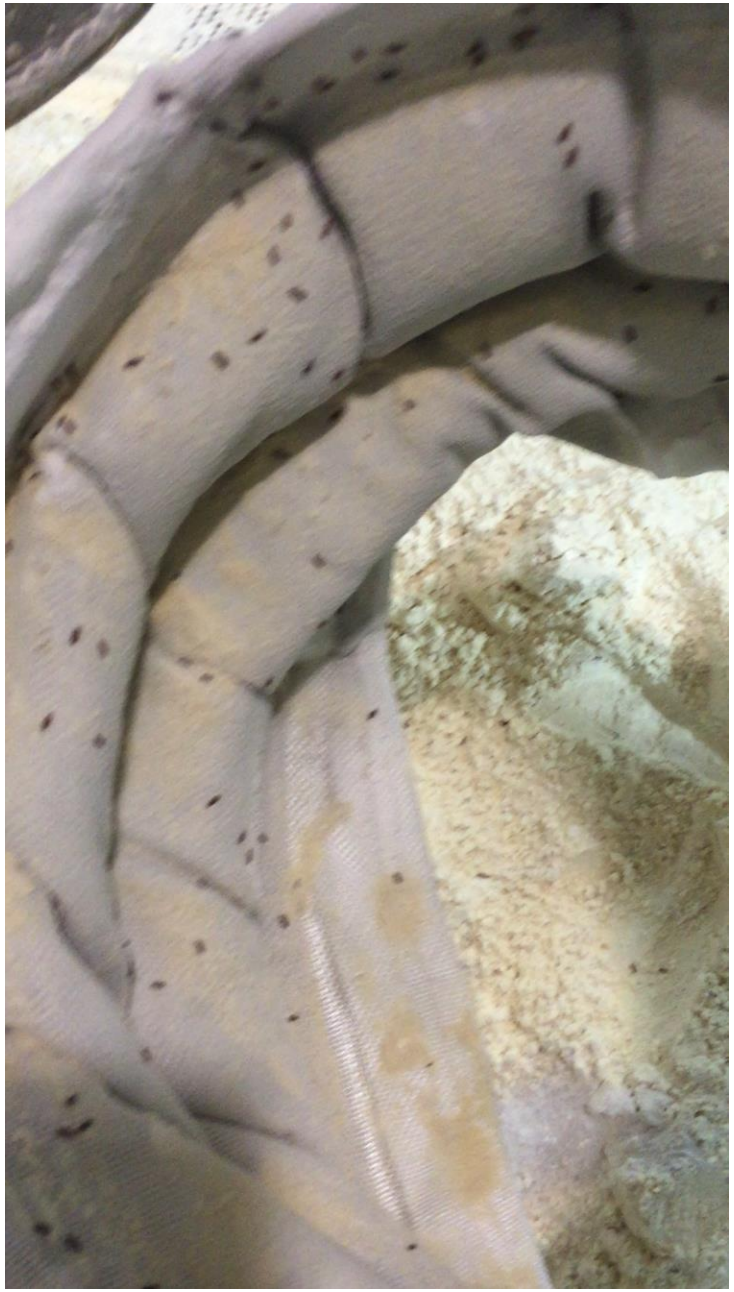






Stay Curious…

- **Mindset** (motivation) Matters
  - Status Quo
  - Problem solver
- The **Type** of **Pest** Matters
  - Feeding **patterns** and **biology** are **leading** indicators
  - Follow the **Evidence**
- The **Site** and Manufacturing **Process** Matter
  - Identify the pattern
  - Where are the **Immobile** life stages
  - **Idle Equipment, Dead Zones, Clutter!**



Thank you

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Managing Insects in Harvested Nuts

Speakers: Zhongli Pan (UC Davis)

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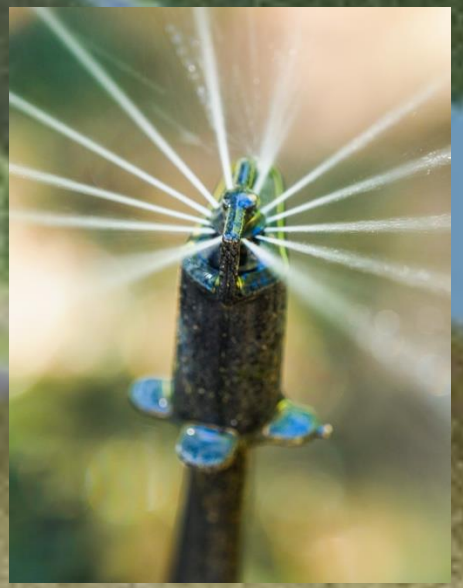
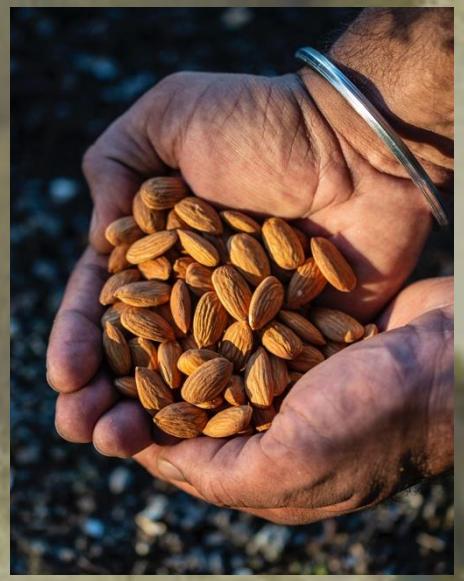
AI-Based SmartProbe Technology for Reducing Pest Management Costs and Food Loss of Stored Products





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Zhongli Pan Ph.D.
Adjunct Professor, UC Davis
CEO and Founder of AIVision Food Inc
zlpan@ucdavis.edu
zpan@aivisionfood.com

Problems of insect pests and high moisture

- Product damage
- Mold
- Product loss
- Food safety risk

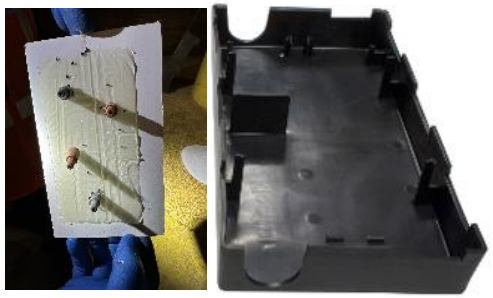






Current practices of insect pest and moisture management

Vector light trap

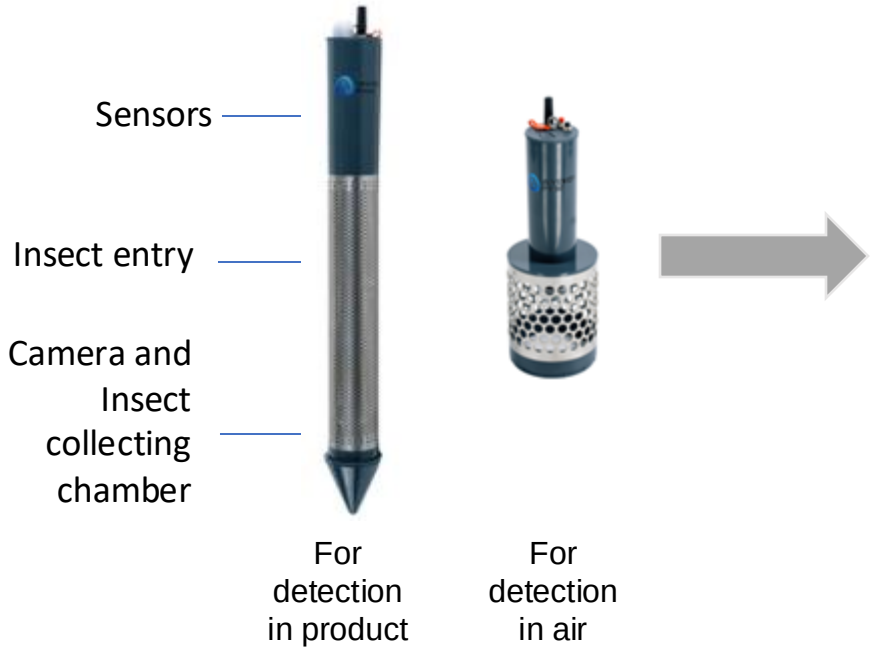


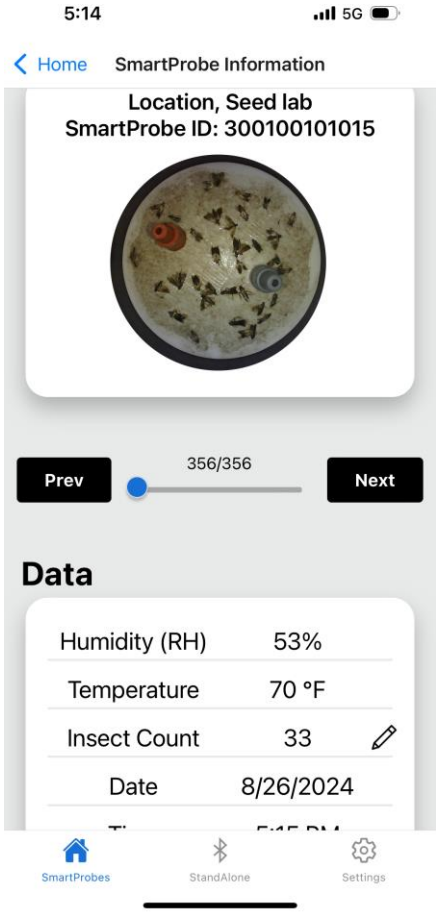
Protecta trapper

Paper sticky trap

- Traps for insect monitoring in environment – human scouting
- No tools for insect and moisture monitoring simultaneously in products

SmartProbe system and APP: Insect early detection and moisture control

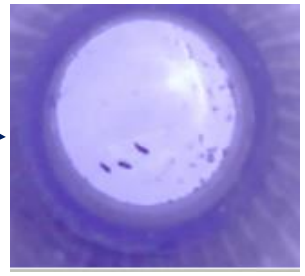


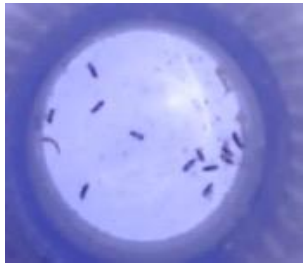


Patent Pending

Results of case study: Almond in a box and bins

SmartProbe





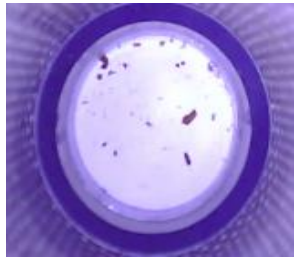
Carton box without plastic liner

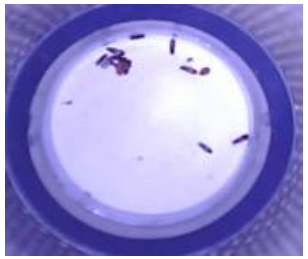
3 days

7days

45 days

SmartProbe





Fiber bin

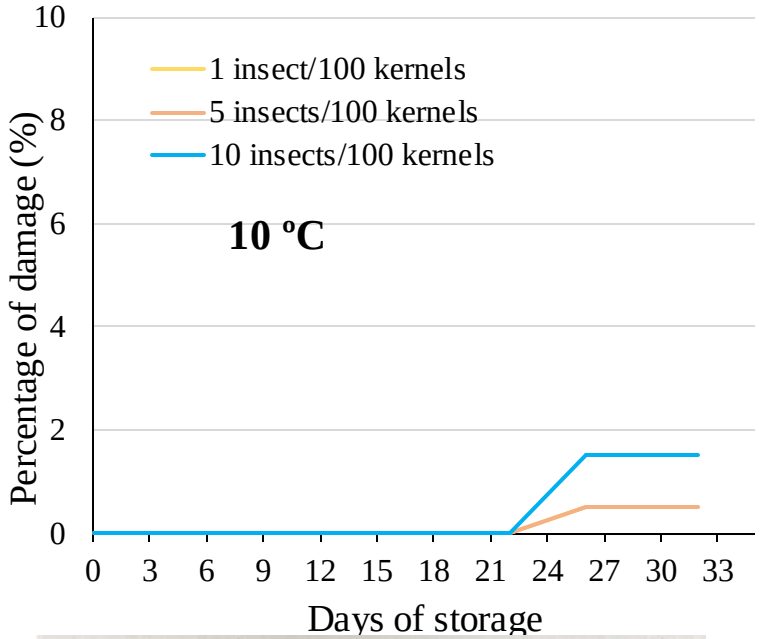
5 days

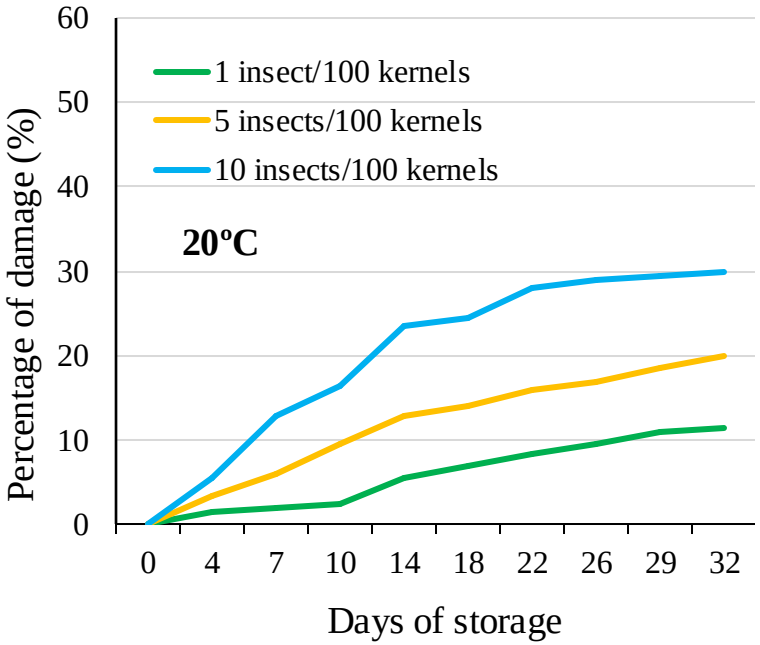
25 days

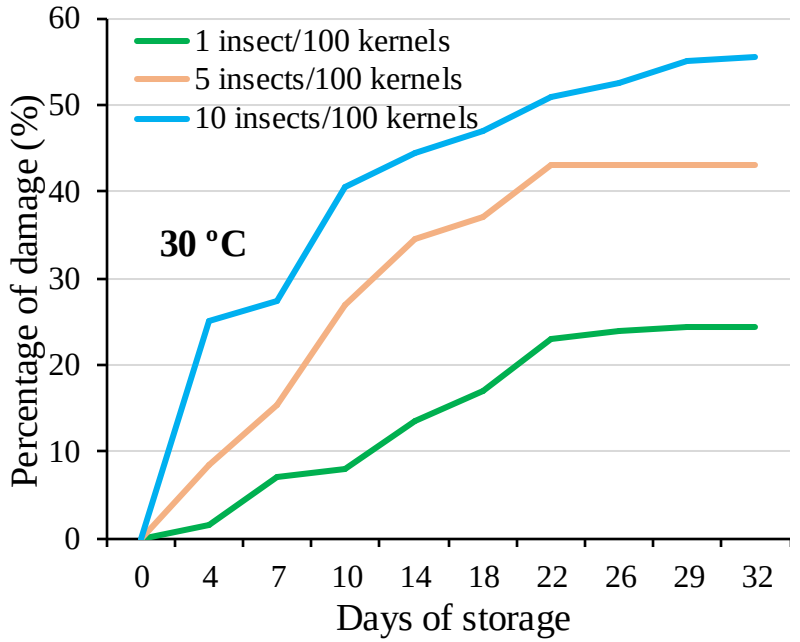
45 days

- SmartProbe detected insects in packaged almond box and fiber bins in a processing facility

Insect damage rate: Infested almond kernels



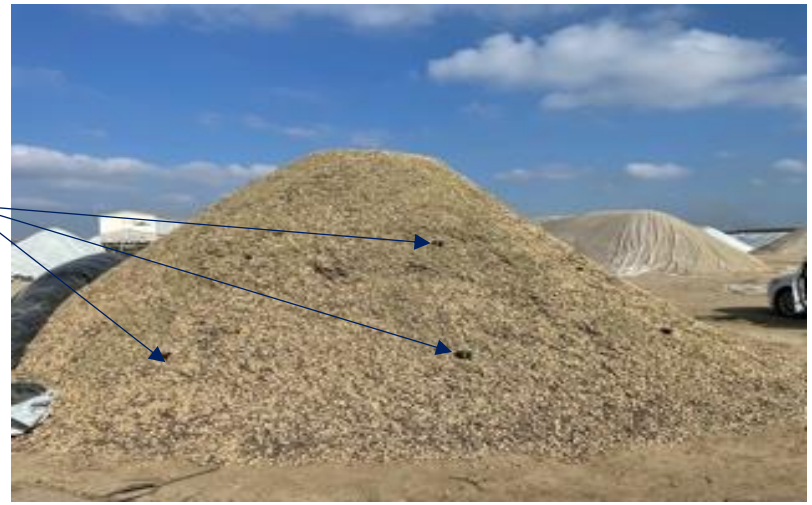




- Red flour beetles quickly caused significant damage to almond kernels.
- Early detection is important.

*Data from the report at Almond Board of California

Results of case study: Almond stockpiles



- SmartProbe detected various insects in stockpiles

- Detected various insects in almond stockpiles
- Monitored the effectiveness of fumigation to achieve precision treatment

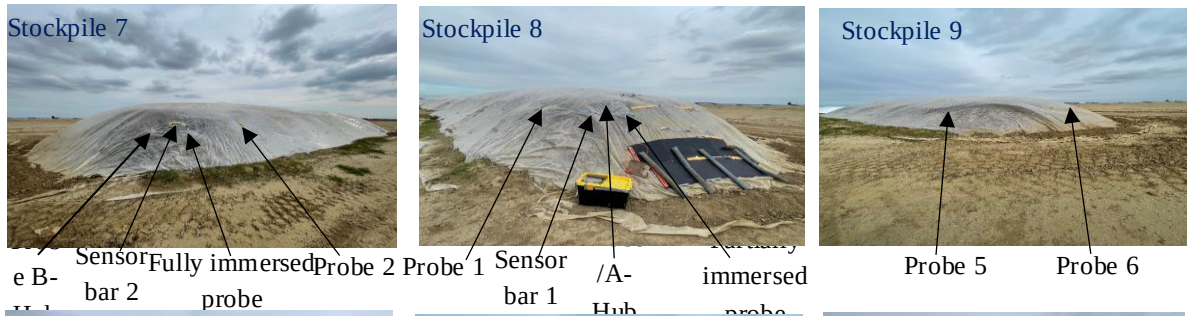
Case study results: Insects started from the surface layer

Probes with live video cameras and temperature and relative humidity sensors to Investigate insect infestation and its location characteristics

SmartProbe

Case study results: Significant insect damage and mold in stockpiles

> 2% increase in damaged rate in infested stockpiles during a two-week period



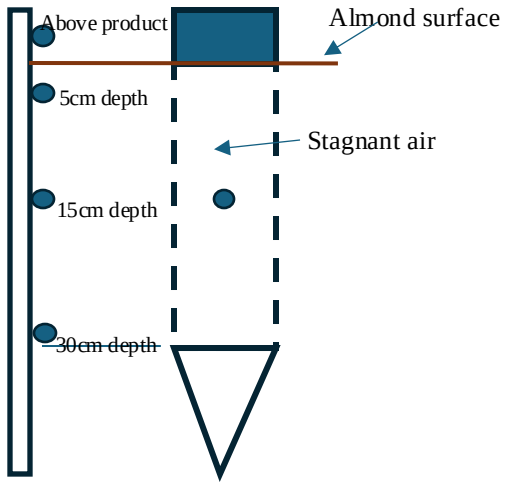
Stockpile	Sample	Replicate	Insect damaged rates	Discolored kernel rates	Total insect damaged and discolored kernels
7	Initial	R1	11	19	30
		R2	11	16	27
		R3	12	18	30
		Average (%)	11.3±0.4	17.6±1.2	29±1.4
	Final	R1	15	14	29
		R2	12	13	25
		R3	15	14	29
		Average (%)	14.0±1.4	13.6±0.4	27.6±1.8
9	Initial	R1	8	18	26
		R2	6	17	23
		R3	11	15	26
		Average (%)	8.3±2.0	16.6±1.2	25.0±1.4
	Final	R1	11	21	32
		R2	9	11	20
		R3	11	18	29
		Average (%)	10.3±0.9	16.6±4.1	27.0±5.0
10	Initial	R1	5	6	11
		R2	7	12	19
		R3	7	8	15
		Average (%)	6.3±0.9	8.6±2.4	25.0±3.2
	Final	R1	11	8	19
		R2	8	10	18
		R3	9	8	17
		Average (%)	9.3±1.2	8.6±0.9	18±0.8
11	Initial	R1	12	22	34
		R2	8	27	35
		R3	9	30	39
		Average (%)	9.6±1.6	26.3±3.2	36±2.1
	Final	R1	9	11	20
		R2	10	27	37
		R3	10	26	36
		Average (%)	9.7±0.4	21.3±7.3	31±7.7

Case study results: Moisture monitoring – Lab test

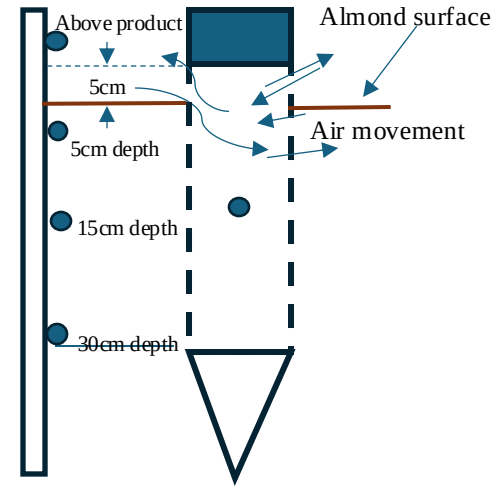
Sensor		ABC	
MC% Almond samples	RH (%)	MC (%)	RH%
9.0	55.6	8.3	56.0
10.7	64.8	10.9	65.0
12.0	69.7	12.2	69.0

ABC: Almond Board of California (Stockpile Management Best Practices)

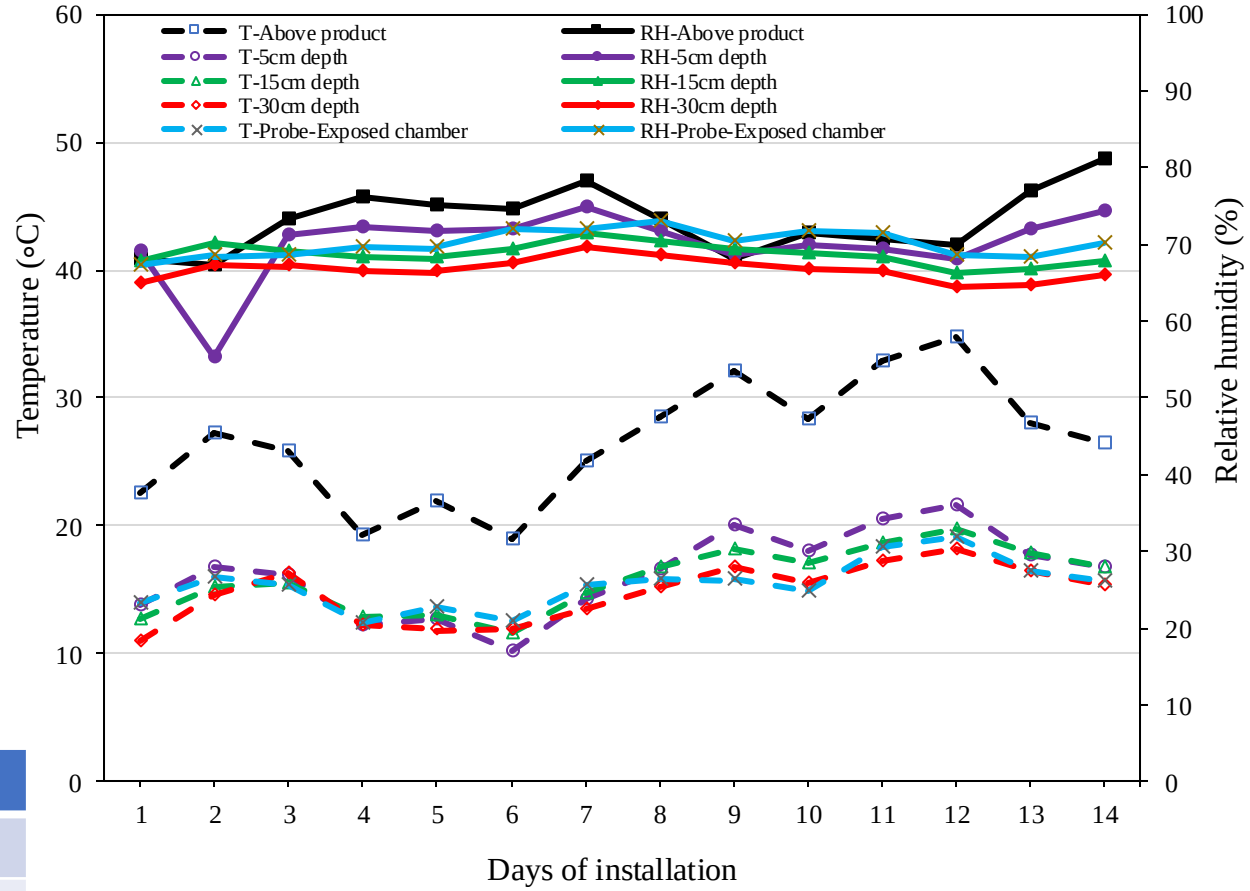
Case study results: moisture monitoring – RH in stockpiles



Bar 2 Fully immersed probe in almonds



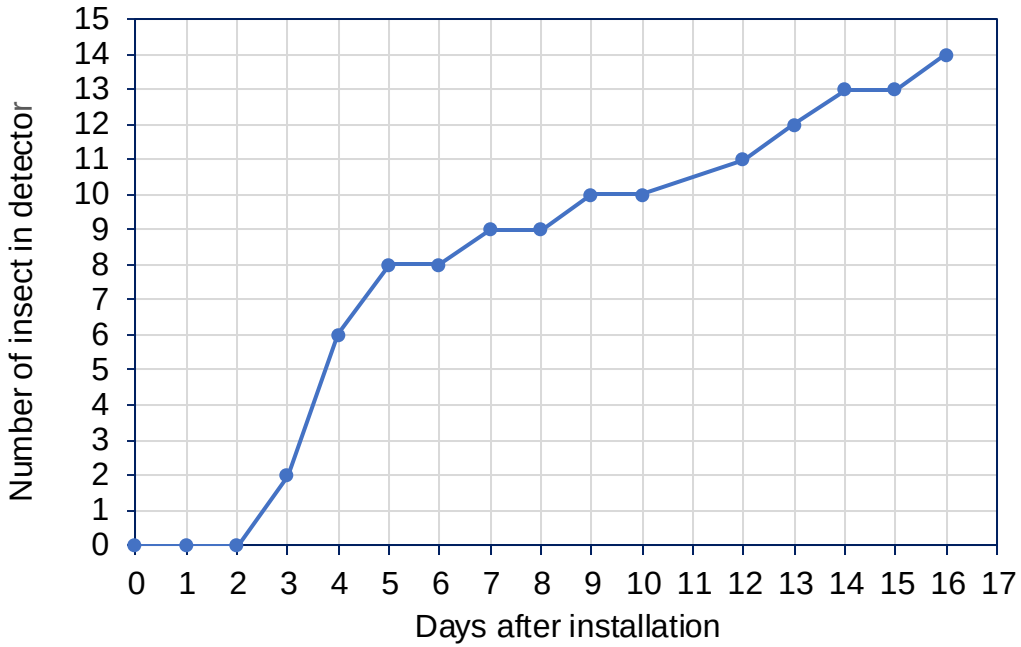
Bar 1 Partially immersed probe in almonds



Average RH from probe (%)	Average RH from Sensor (%)	MC (%)	
		ABC	Measured
70.1±1.7	70.1±4.7	12.55	12.32 ±0.2

ABC: Almond Board of California (Stockpile Management Best Practices)

Case study results: Monitoring insect activities in storage



2 days

7 days

10 days

15 days

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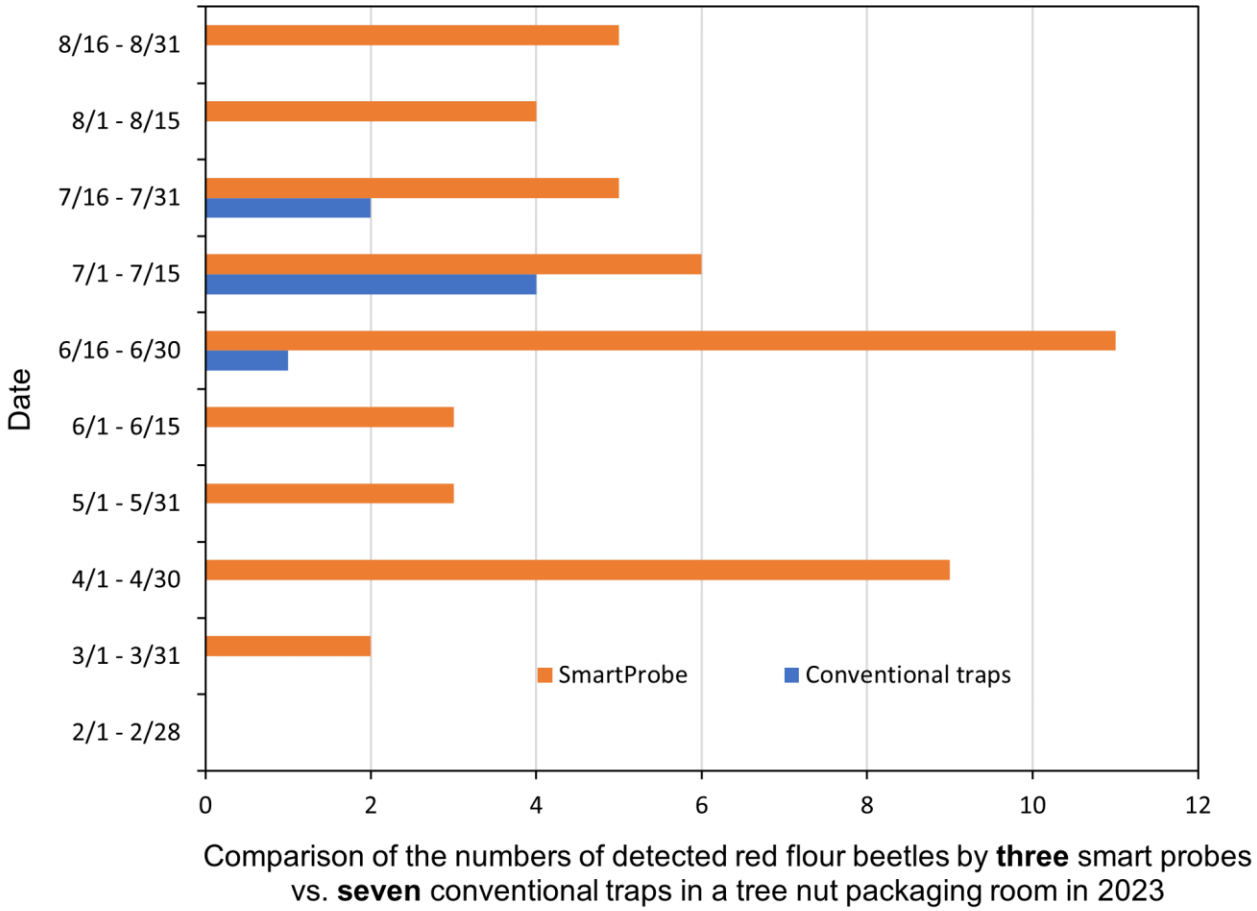
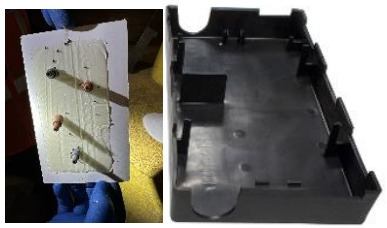
Results of case study: Insect activities in packaging room



Comparison of the numbers of detected red flour beetles by **three** smart probes vs. **seven** conventional traps in a tree nut packaging room in 2023

VS.

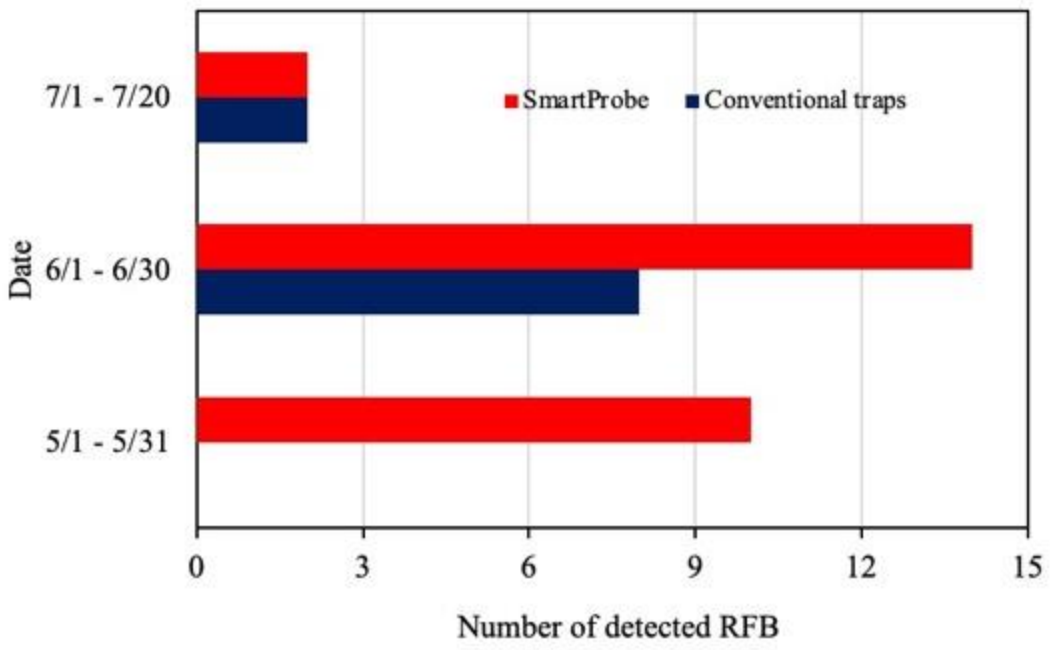
Vector light trap



Protecta trapper

SmartProbe is much more effective than conventional traps

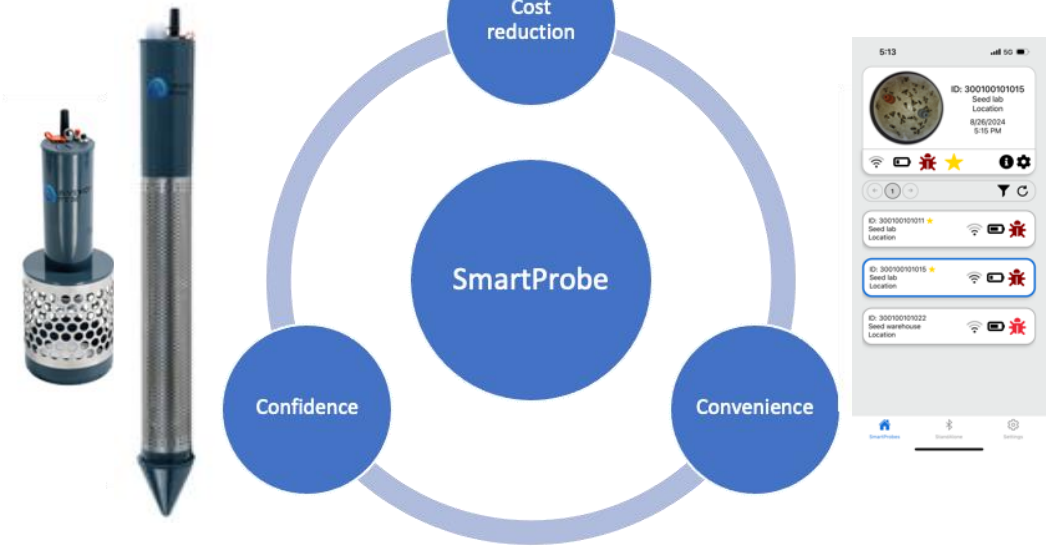
SmartProbe effectiveness vs. conventional traps in dusty environment



One SmartProbe vs. two conventional traps in the Building #25 from 5/1/24 to 7/20/24

SmartProbe competitive advantage – Multifunctional probe

- ✓ Only available AI-based technology
- ✓ Monitor insects and product moisture
- ✓ Record environmental conditions
- ✓ Work under WiFi and Offline modes
- ✓ Automatic notification
- ✓ Ensuring regulatory compliance
- ✓ Significant IPM labor cost saving
- ✓ Easy to use and maintain

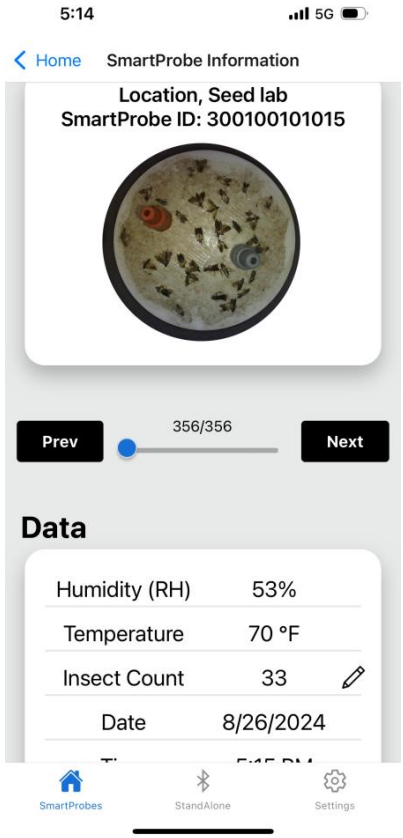


VS

Current insect traps with human inspection

Significant saving in labor cost for IPM

- Labor cost for current IPM practices
  - $40 per hour
  - 15 min for checking each trap
  - $10 per trap checking
  - One time per week
  - $520/trap/year
- SmartProbe
  - Work 24/7
  - Last several years
  - ROI – one year?
  - Other savings



Applications of SmartProbe

- Processing rooms
- Warehouse
- Bins
- Stockpiles

Technology supporters, collaborators and paid users

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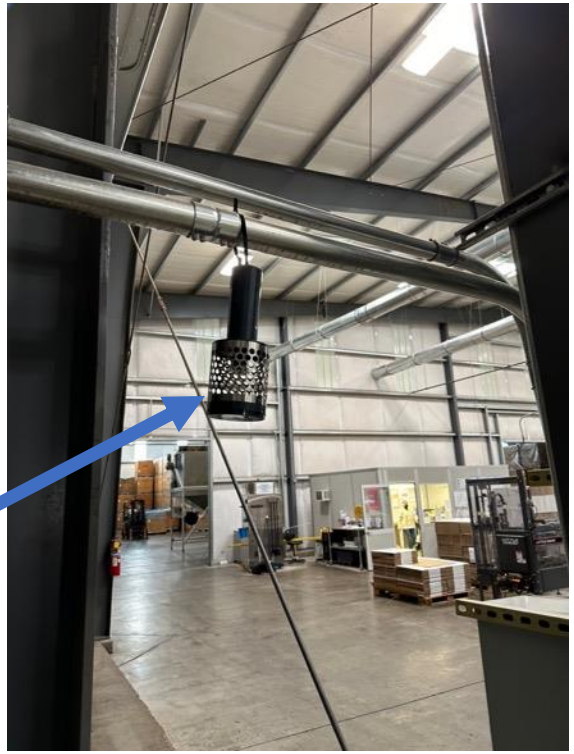
SmartProbe ready for you

SmartProbe APP

Smart probe

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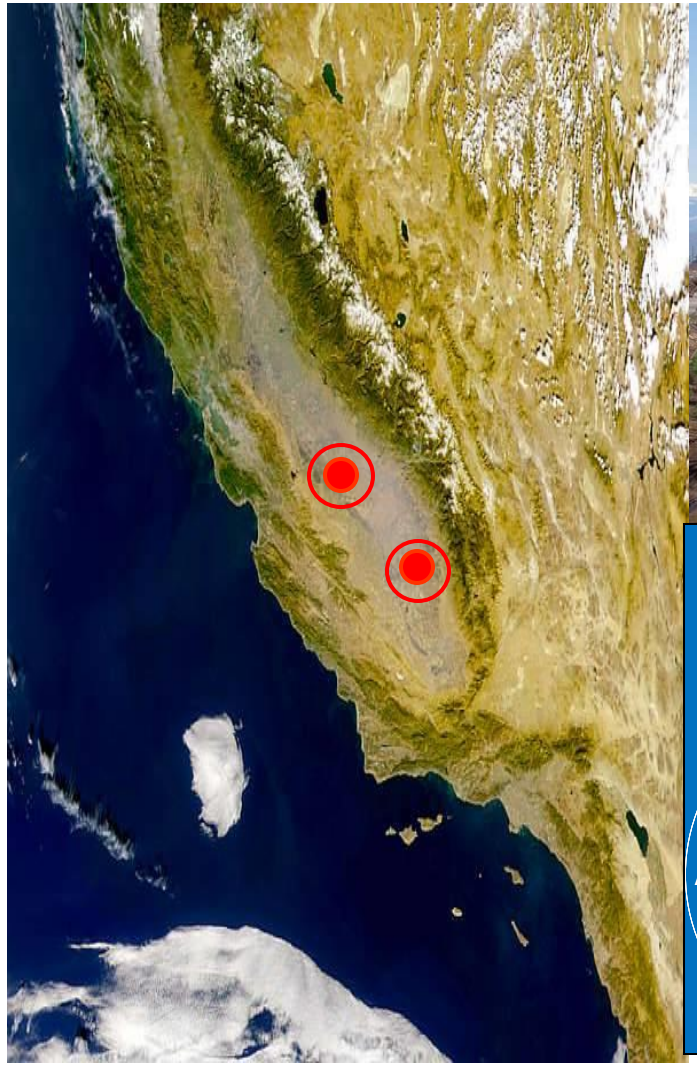
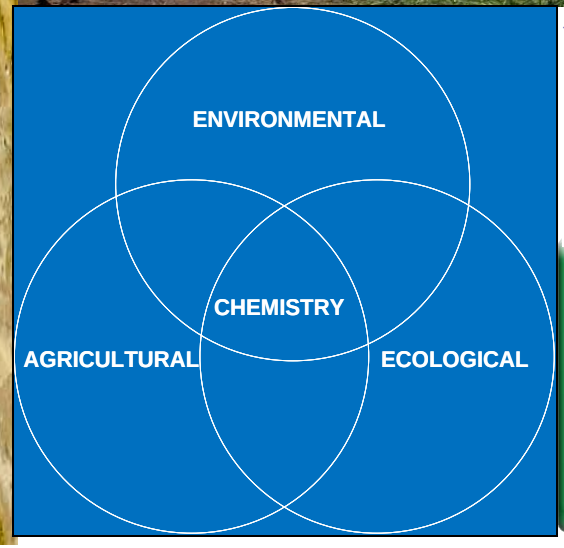
Postharvest Fumigation for Food Security & Safety

Spencer Walse

http://agchem.ucdavis.edu/

http//fresno.ars.usda.gov

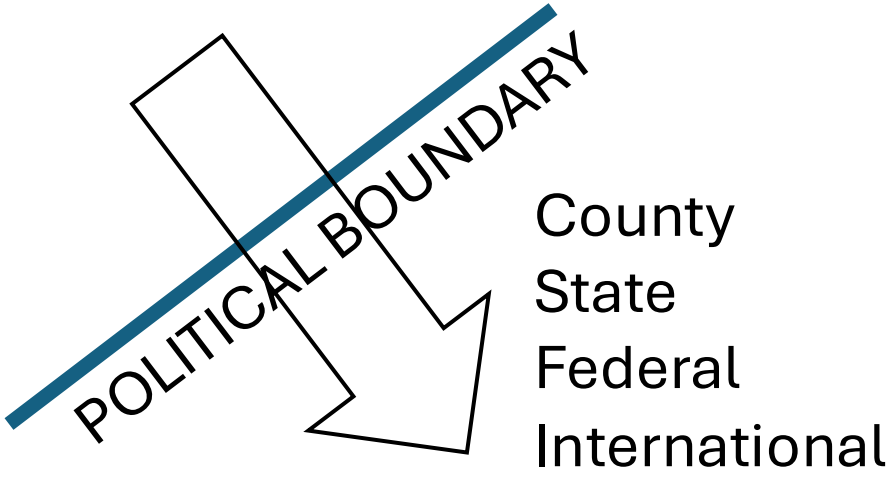




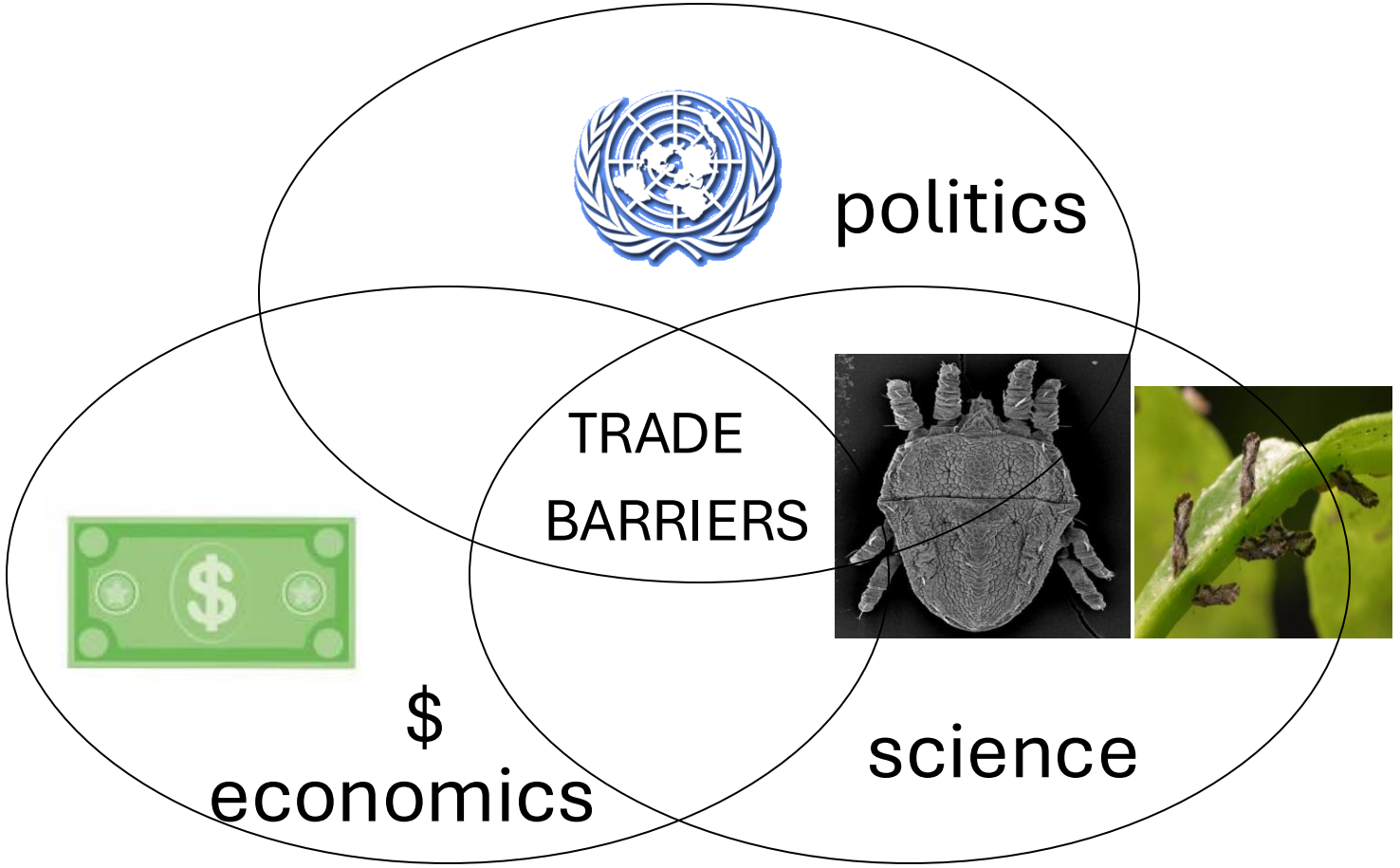
USDA Agricultural Research Service

San Joaquin Valley Agricultural Sciences Center

“Agricultural Trade”

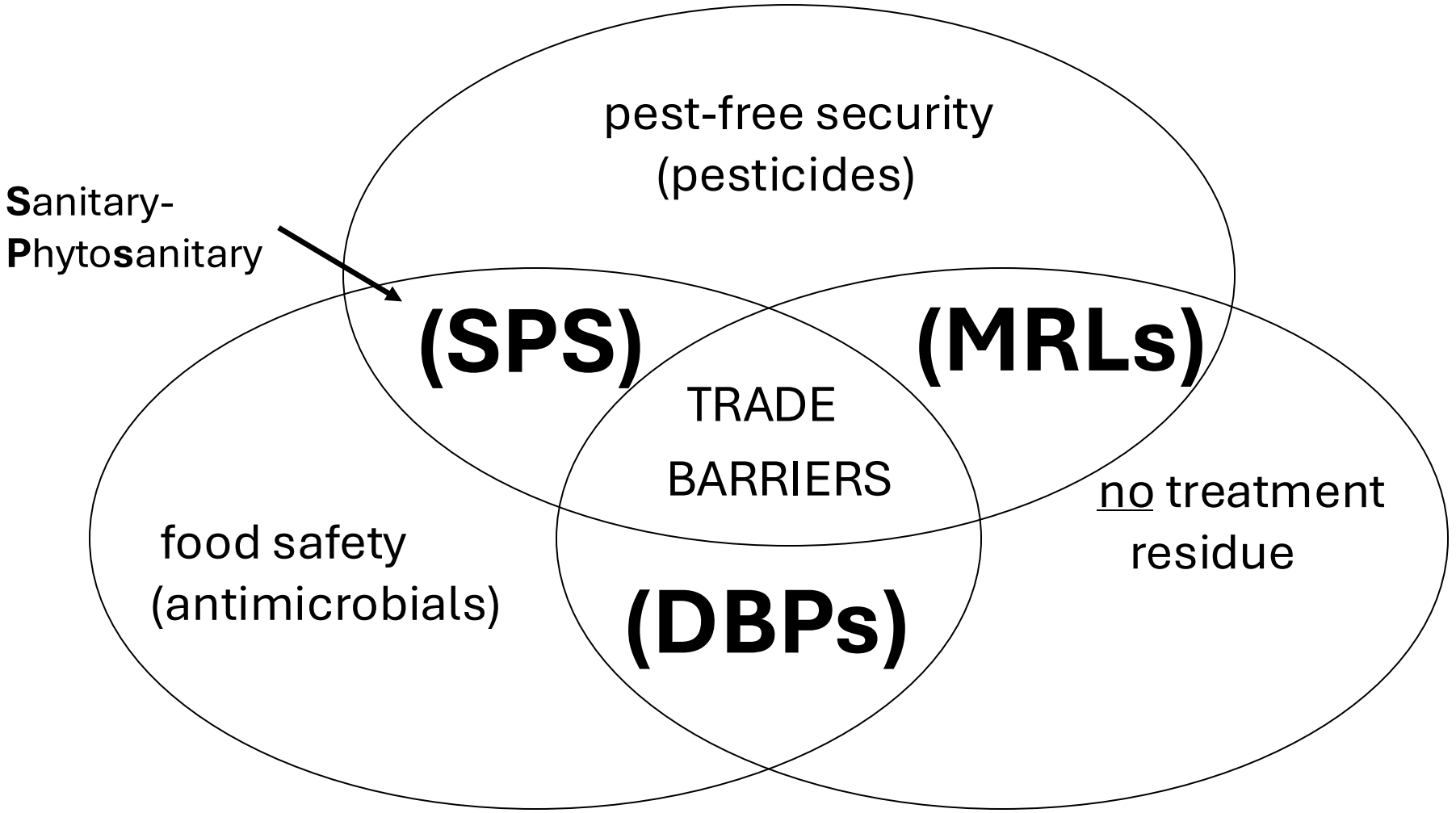


County
State
Federal
International



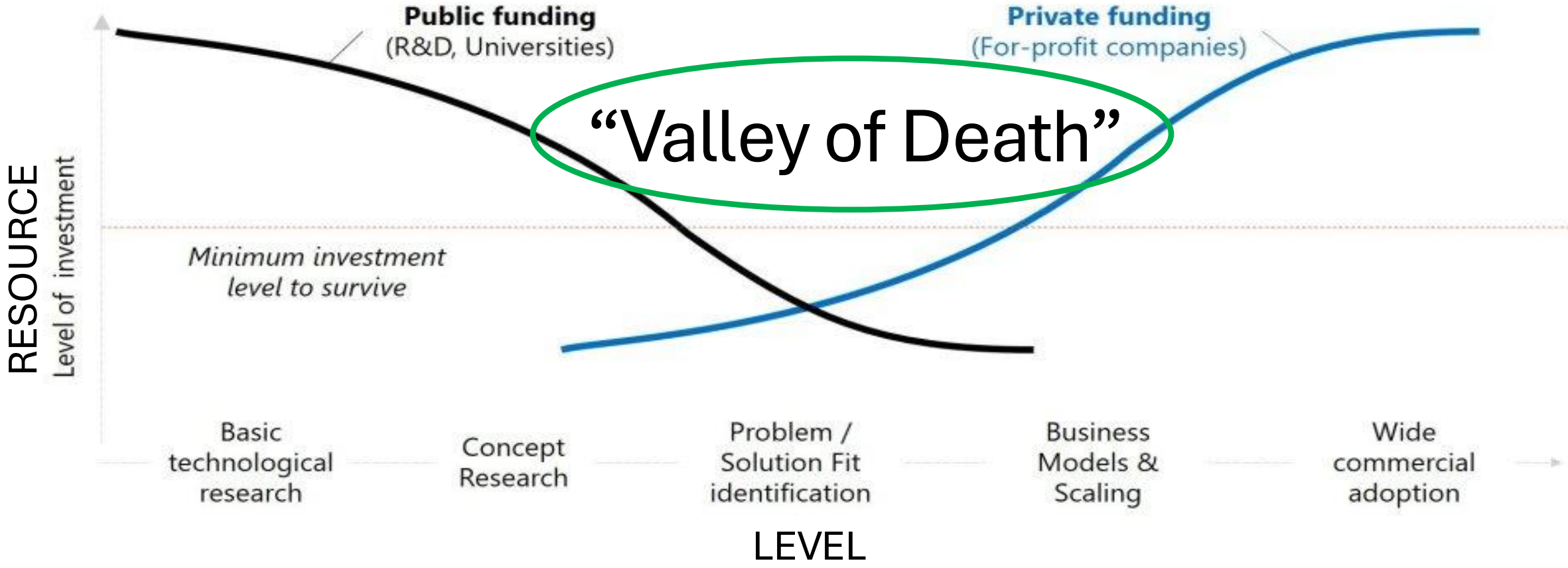
Walse group (Proactively) Addresses
Consumer & Regulatory Demands.....

Ag Trade Research Demands



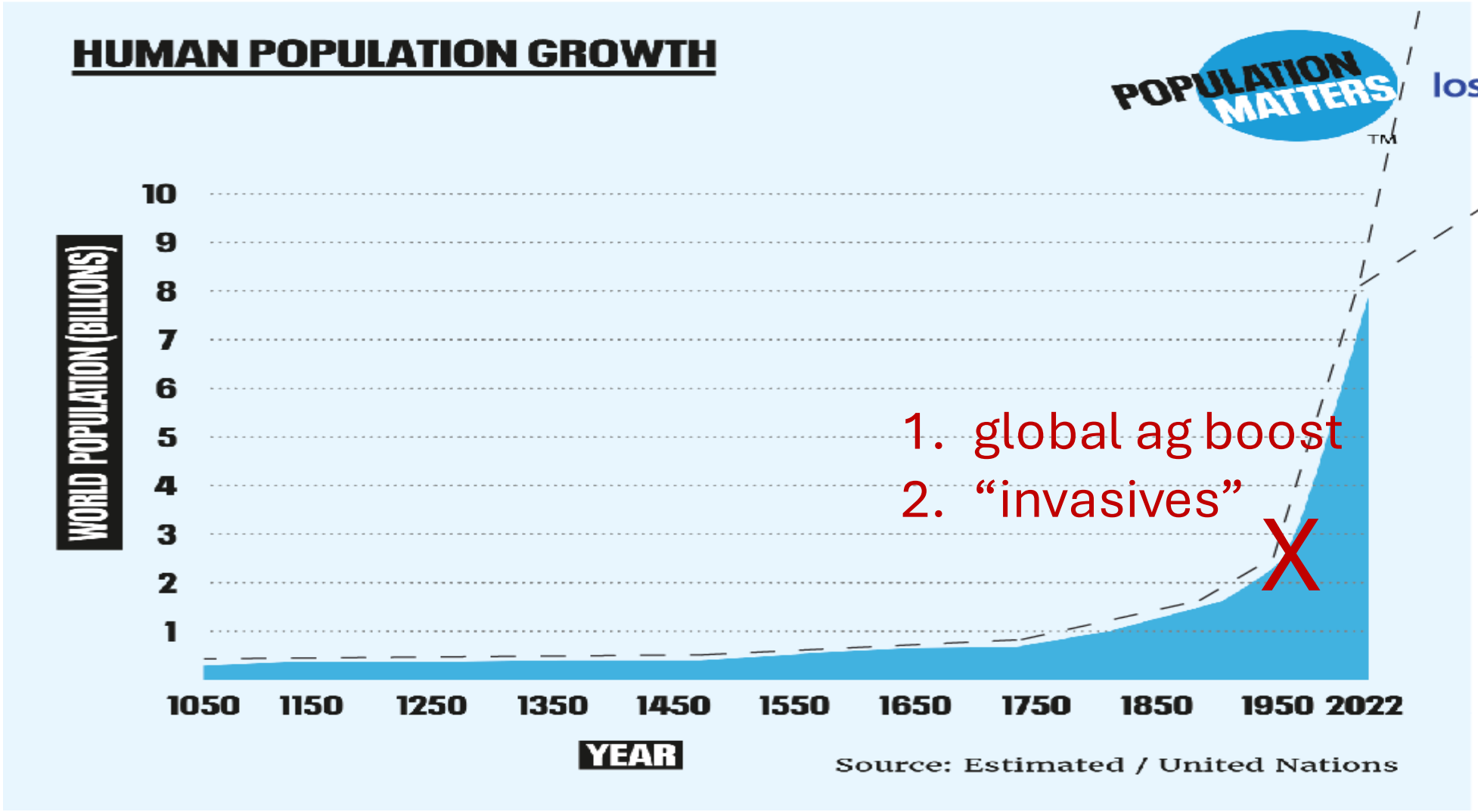
Agricultural Conundrum –must use biocidal chemicals, but can't????
(biologicals)

“Highly applied **SPS** research” focused in the……



idea to value.com
The community for creativity and innovation

“**SPS** big picture/challenge”



1-slide take home..... postharvest is key to SPS!

or

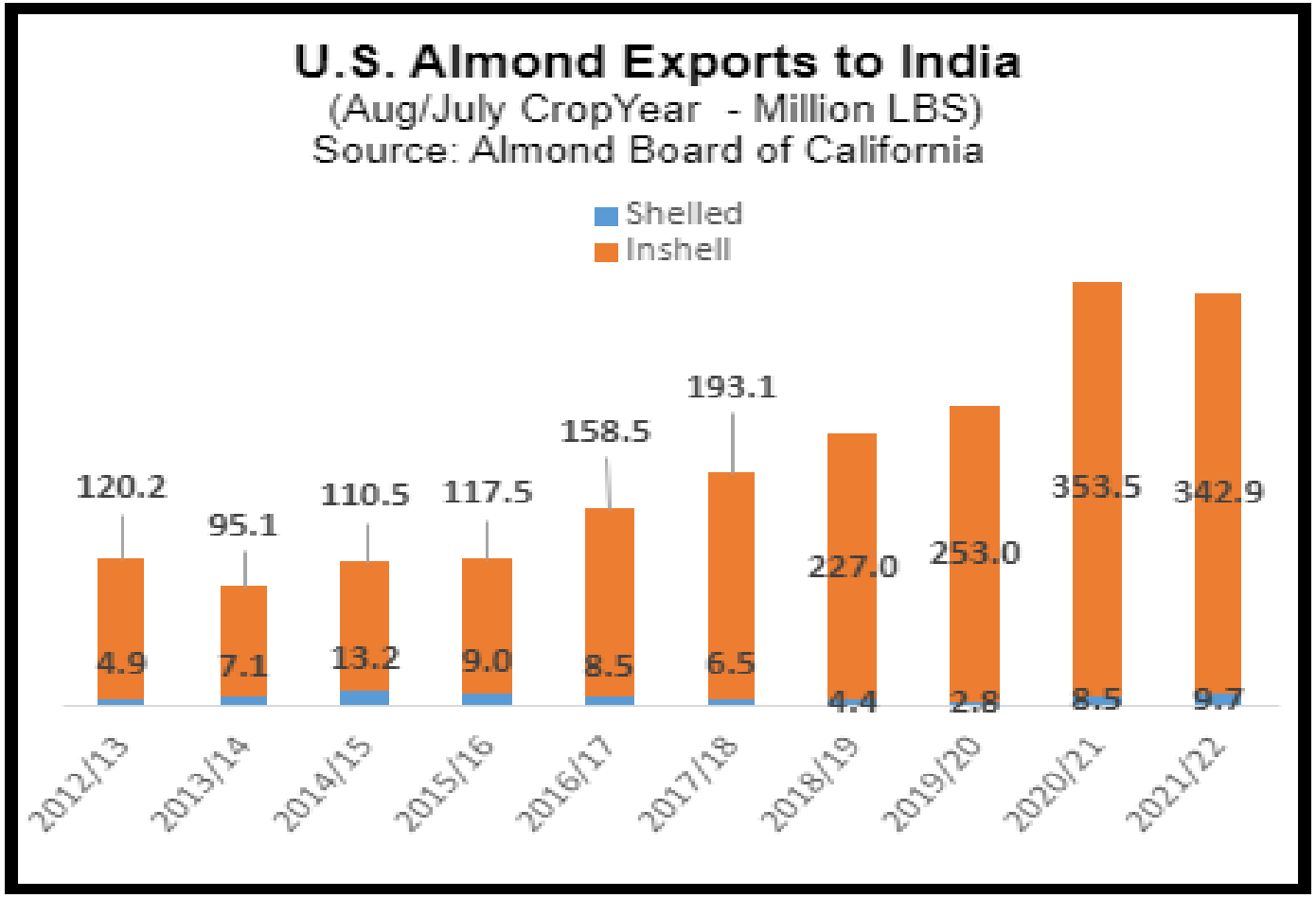
"postharvest" fumigation is best suited to satisfy SPS demands &
current trends in consumer → regulatory

California Department of Pesticide Regulation

Sustainable **P**est **M**anagement must reflect SPS rules, needs, trends

Walse to author SPM chapter on "commodity fumigation"

Snapshot of SPS fumigation chronology- almonds



ARS Parlier developed.....

- methyl bromide in 1970s
- metal phosphides in 1980s
- phosphine in 2000s
- -PPO & steam in 2000s
- -sulfuryl fluoride in 2010s
- -low O_2 is 2020s

APPLIED RESEARCH NEVER STOPS!

ARS Parlier SPS research has generated > 2 Trillion USD total for almonds!

SPS fum targets vs. timing

NOW

Carob moth

field pests

PATHOGENS

- incoming
- storage
- outgoing

RFB

IMM

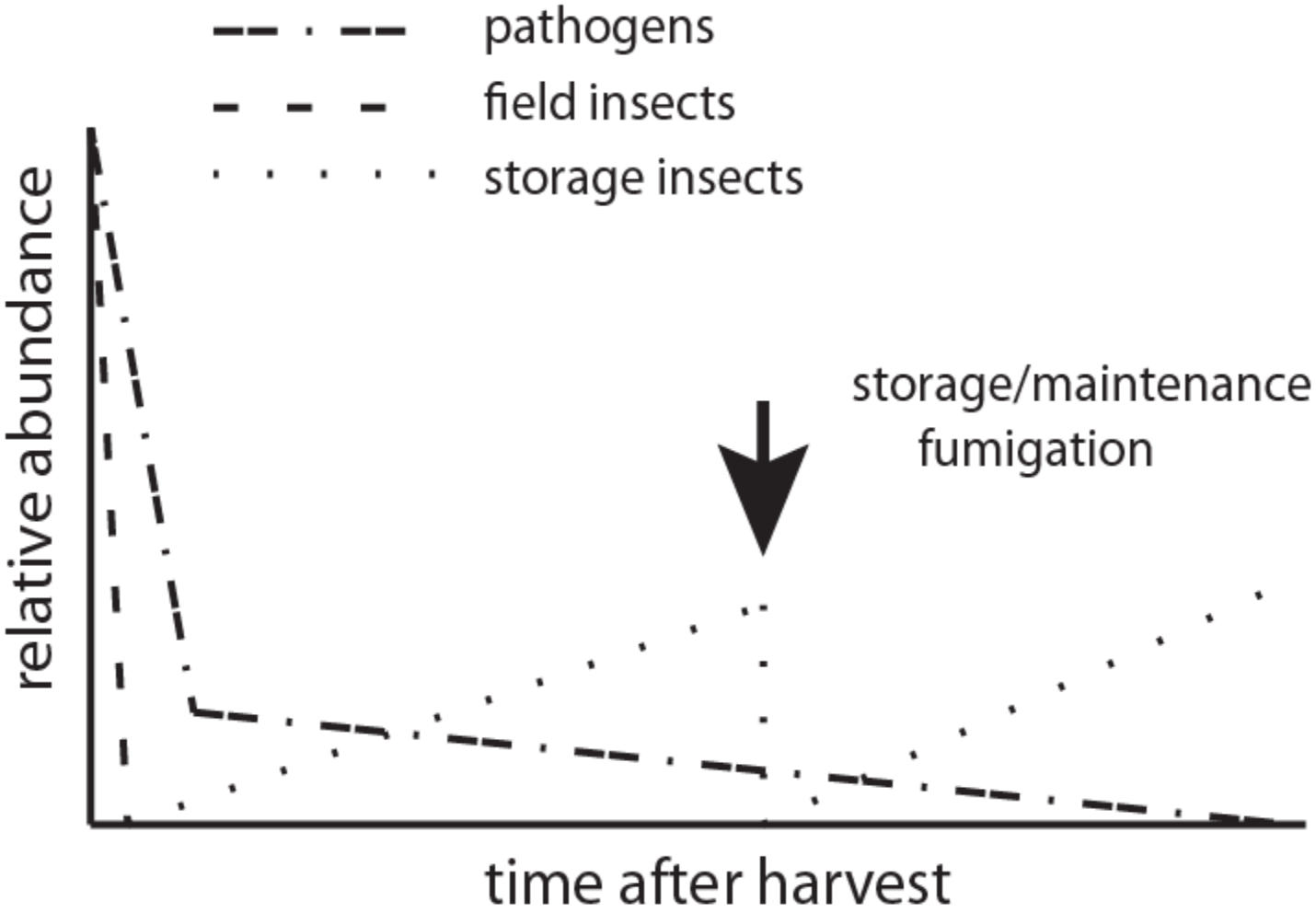
storage pests

DFB

Almond SPS fum logistics and initial history

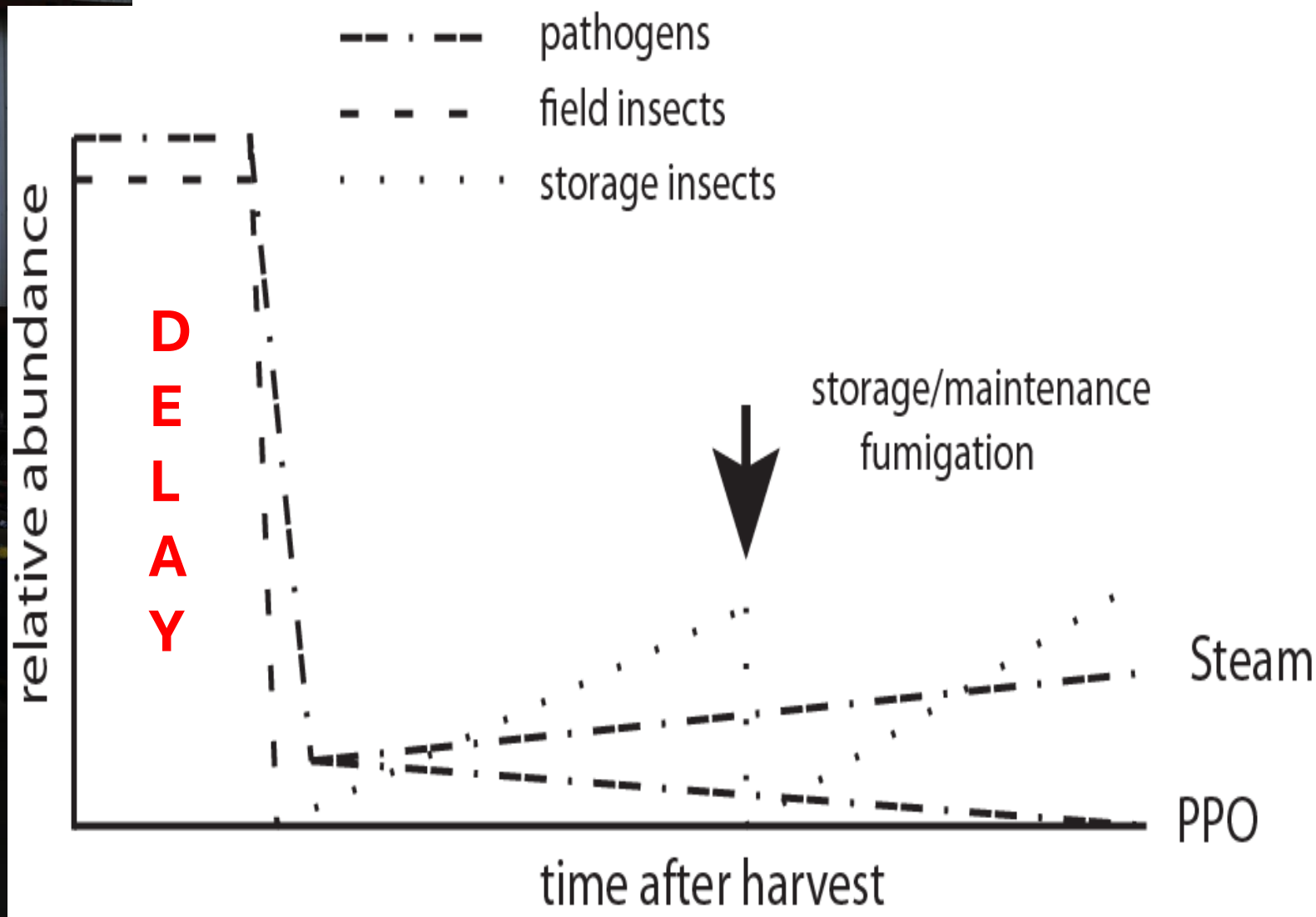
"MB and its fallout"

4-h vacuum
or
24-h atmospheric



Almond SPS Pasteurization “ripple”

Not easy on incoming!



Almond SPS challenges

How to:

- more “conveniently” address pathogens?
- rapidly disinfest (< 5 days) **field insects** (SF, PH3 & alternatives do not work on the MB timescale)?
- synchronize **storage fumigations** with timing of egg hatch (vis-à-vis larvae →mold)?

spencer.walse@usda .gov
Cell: 559-779-8750

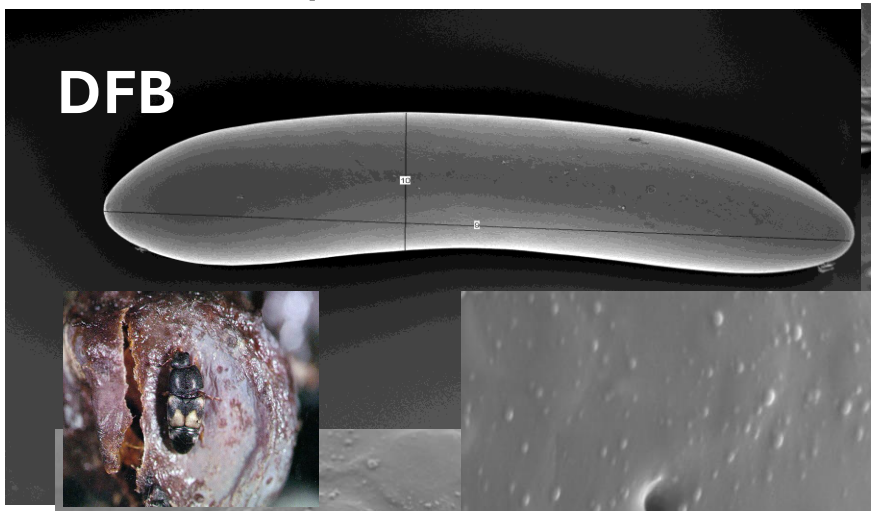
Poster 58

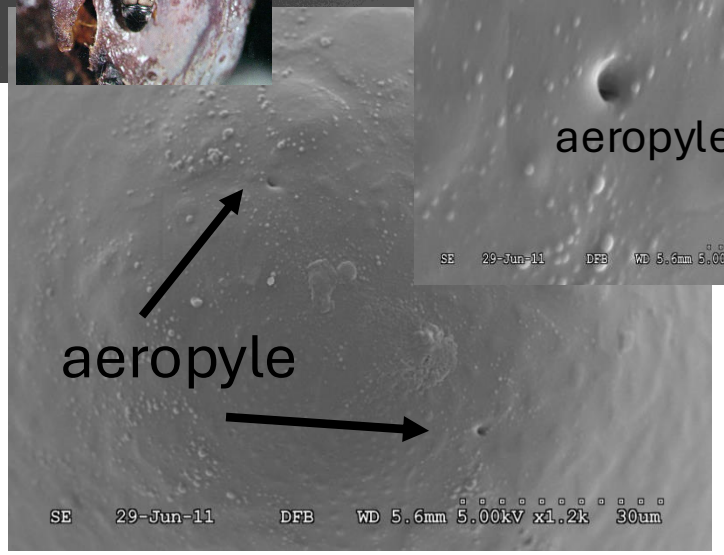
Carpophilus truncatus update

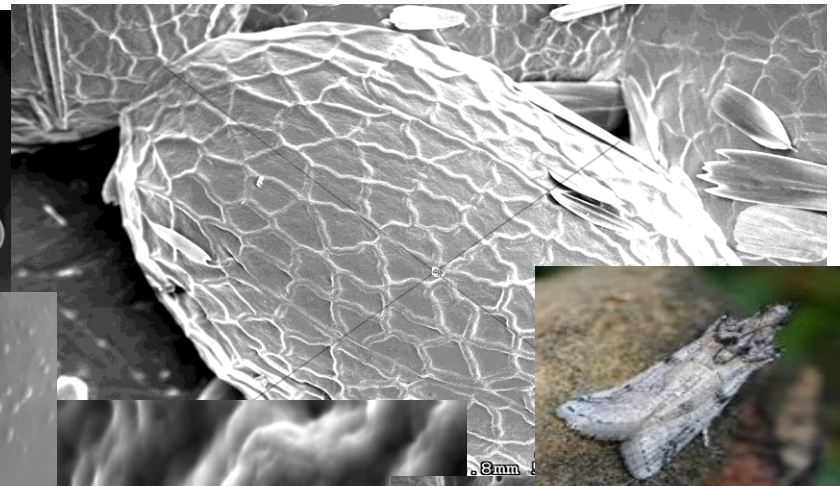
C. hemipterus

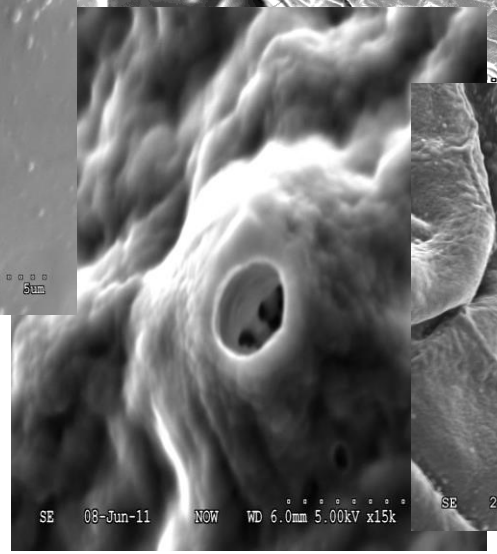
A. transitella

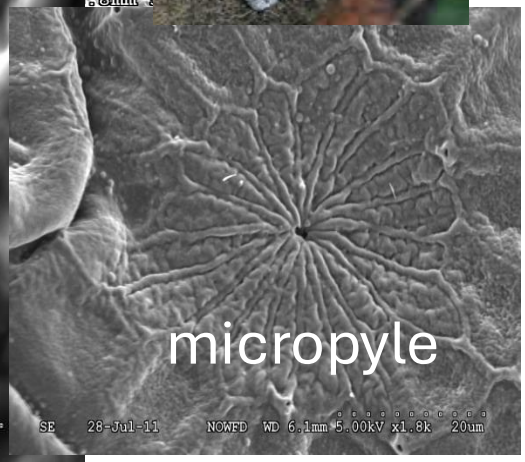
NOW











C. truncatus has no egg holes!

1) think RFB and CFB control
2) but, it is on “incoming!”

diffusion → metabolism ($C \leq t$)
PH3, HCN
“easier”

diffusion → reaction ($C \geq t$)
MB, SF, PPO, EF
“easier”

2024

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Q&A


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