SmartProbe Technology for Reducing Food Loss and Chemical Use

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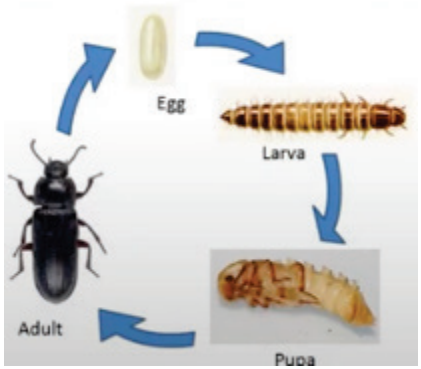
Mission

- Reduce food loss during storage, processing and handling
- Reduce hunger
- Make food production and supply more sustainable

AIVISION FOOD

Major Pests in Stored Food and Agricultural Products

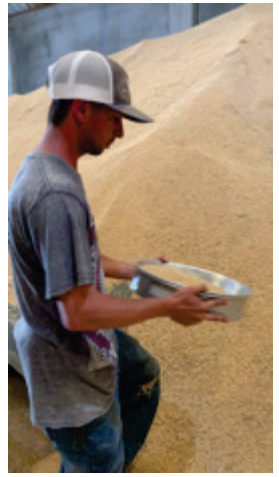
- Flour moths
- Grain moths
- Rice weevil
- Less grain borer
- Red flour beetle
- Angoumois grain moth
- Indian meal moth



Significant Cereal Product Loss in Postharvest

- 19% in developing countries
- 9% in developed countries

Product loss and pest treatment are expensive



Inaccuracy

Human visual inspection can not find pest until it's **too late.**
Insect infestation **causes over 20%** cereal loss in developing countries

Expensive

Current chemical fumigation and product loss cost over **$350M** each year for **tree nuts alone** in U.S.

Health & Food Safety

Toxic chemicals used for fumigation impact worker health and food safety.

Rice Loss Caused by Insect Infestation

Storage Facility	Storage type	Rice category	Milling quality		
			TRY (%)	HRY (%)	WI
A	Metal (Bin 47)	Infested rice	64.81±0.32 a	58.12±0.18 a	40.10 ±0.20 a
		Clean rice	67.57±0.17 b	60.88±0.15 b	40.23±0.33 a
	Metal (Bin 48)	Infested rice	64.16±0.25 a	57.18±0.47 a	39.53±0.24 a
		Clean rice	67.57±0.17 b	60.88±0.15 b	40.23±0.33 a
B	Flat warehouse	Clean rice	66.02±0.69 a	59.88±0.62 a	39.63±0.36 a
		Clean rice	66.91±0.51 a	60.86±0.31 a	39.67±0.04 a

- $5.5 loss per ton of paddy rice due to 2.5% milled rice reduction
- Chemical fumigation cost: $2.2 per ton
- $770 for each 100t storage

*based on the rice price in 2021

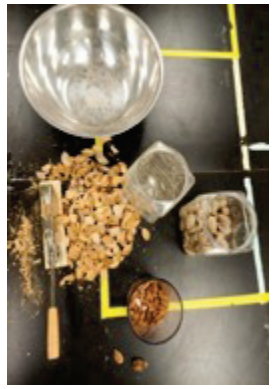
Major Fumigants

- Methyl bromide
- Sulfuryl fluoride
- Magnesium phosphide
- Aluminum phosphide

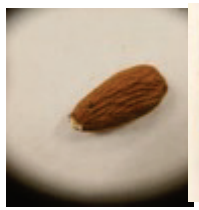
Almond Damage Rates from Insects

- Almonds
  - Kernels
  - In-shell almonds
  - In-hull almonds
- Infestation rate of red flour beetles
  - 1:100, 5:100, 10:100 (insects : almonds)
- Storage conditions:
  - Temperatures: 10, 20, 30˚C
  - Relative Humidity: 64%
  - Storage time: up to 56 days



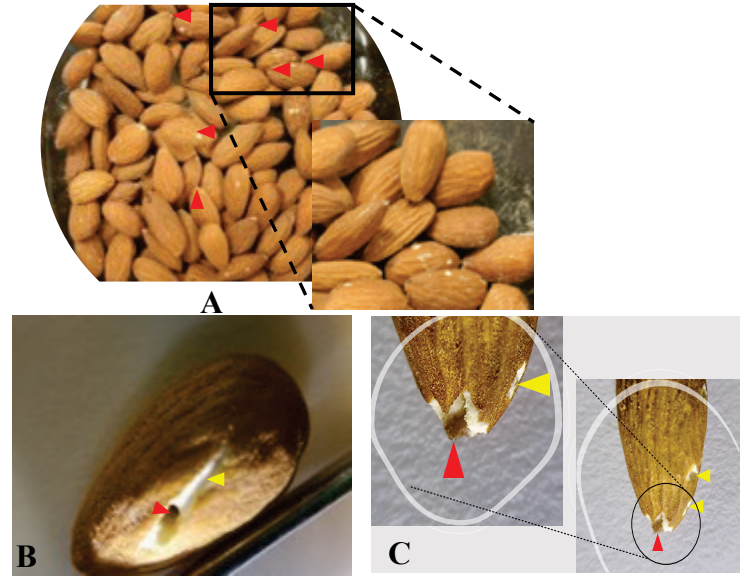


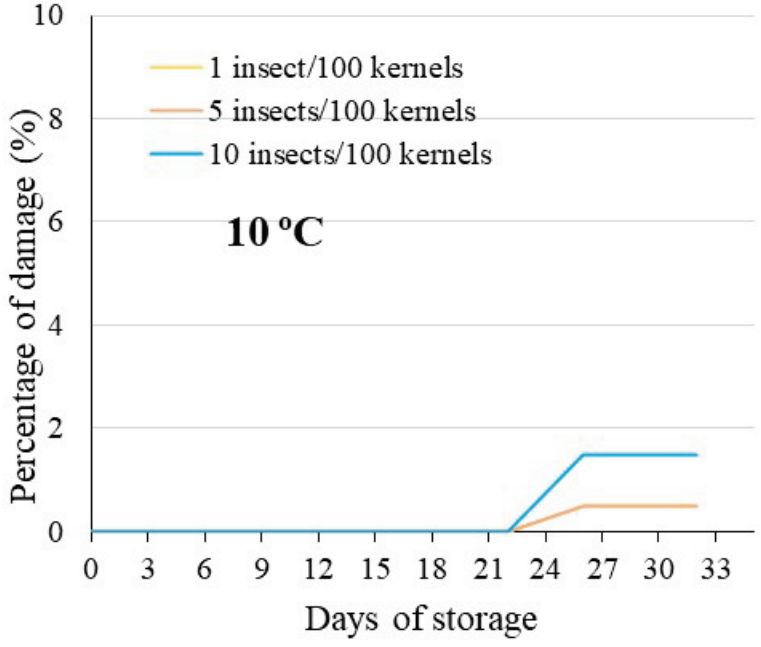



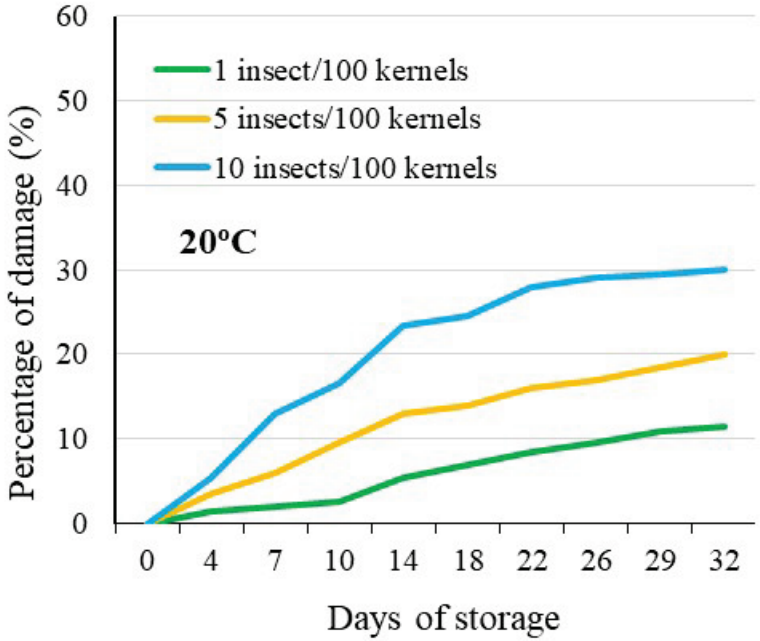

Insect damaged almonds

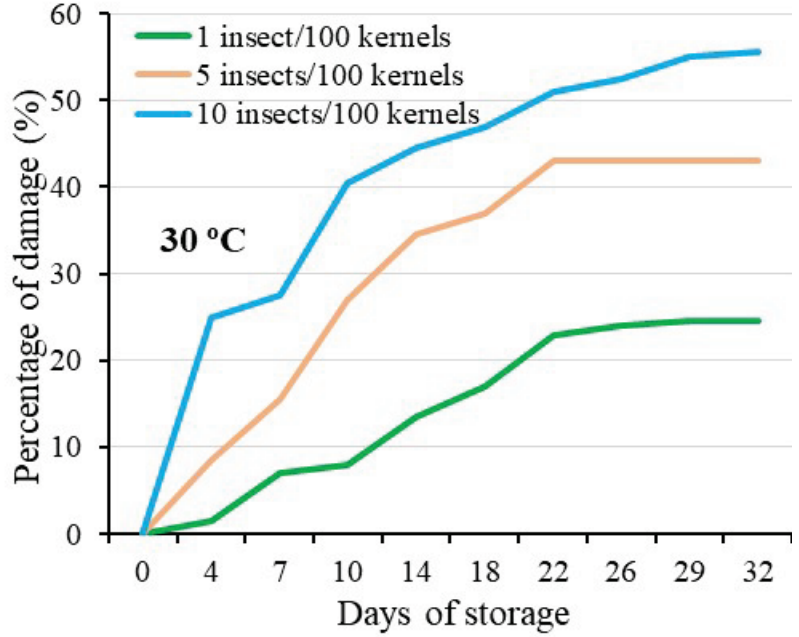
Insect Damage Rate: Infested Almond Kernels

Early detection is important









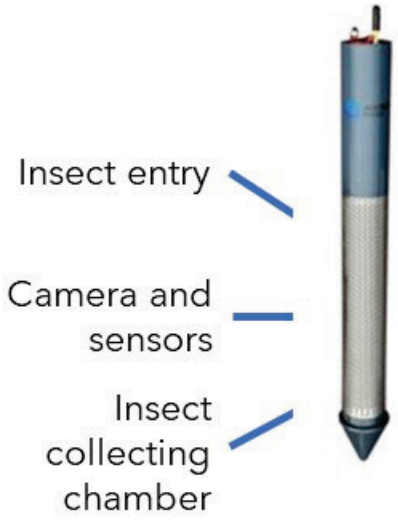
Goals

- Develop a new technology for early detection and environmental monitoring
- Reduce food loss during storage, processing and handling
- Improve food safety
- Reduce pest management cost
- Reduce hungers
- Make food production and supply more sustainable

SmartProbe System for Insect Pest Detection and Environmental Monitoring

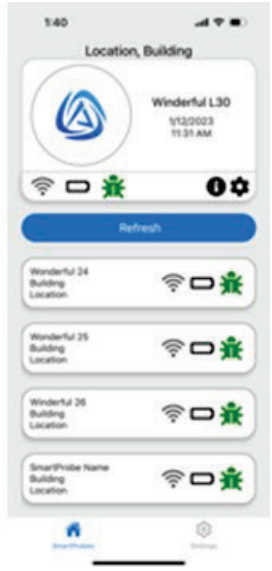
Early detection and control

- Novel design of SmartProbe: detect insects at an emerging stage
- Integrated detector with sensors: capture and photograph insects
  measure and record temperature & humidity
- Cloud computing: analyze images and count insect number, and predict insect occurrences
- Notification: send out information about insects and environmental conditions for taking necessary actions to control the pests



SmartProbe

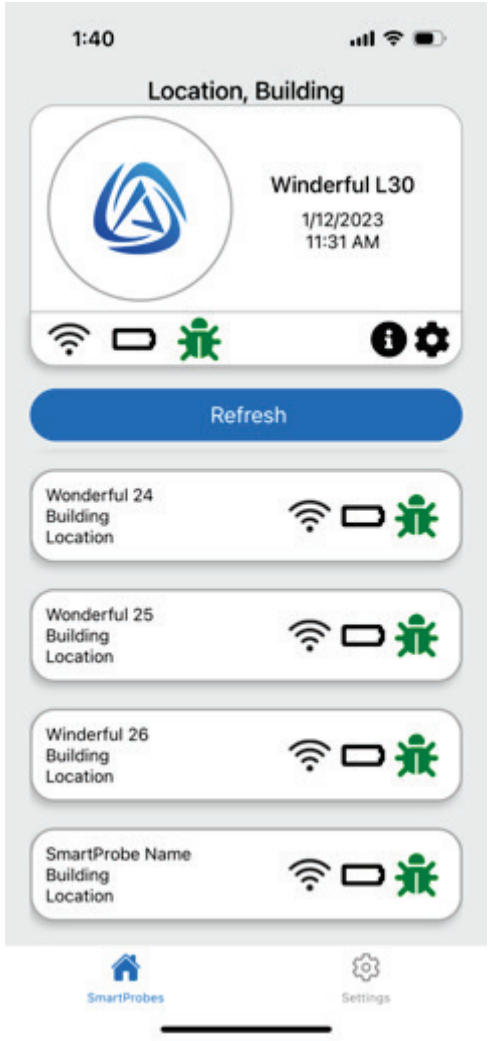
Cloud Data and Computing



SmartProbe User Interface and App

UC Davis Patent Pending

SmartProbe Software and APP



www.app.aivisionfood.com

Advanced SmartProbe Technology

Award winning technology

Detect pest insects early
Monitor environmental conditions

For storage, processing, handling, and transportation

Patent pending (UC Davis)

Demonstration at Rice Warehouses

California Rice Research Board

CALIFORNIA WAREHOUSE ASSOCIATION

Butte County
Rice Growers Association

ERDMAN WAREHOUSE
RICE DRYING & STORAGE

Hi & Dry Warehouse

LUNDBERG FAMILY FARMS

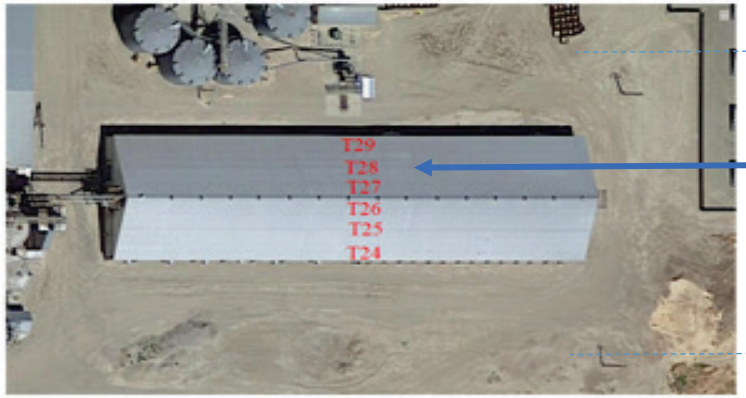
FARMERS RICE COOPERATIVE
Stegeman Station

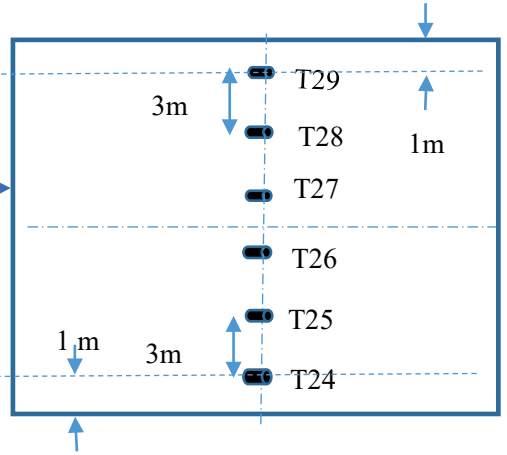
FARMERS' RICE COOPERATIVE

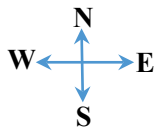
TYNDALL MOUND WAREHOUSE
River Garden Farms Co.
Knights Landing, CA
Rice Drying & Storage

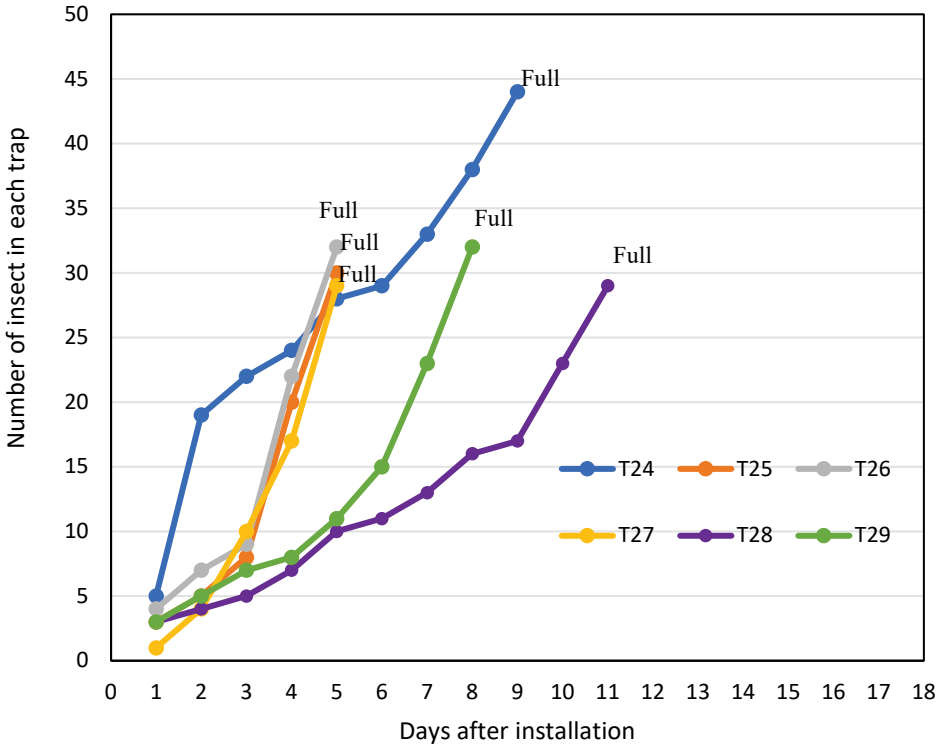
Warehouse #1

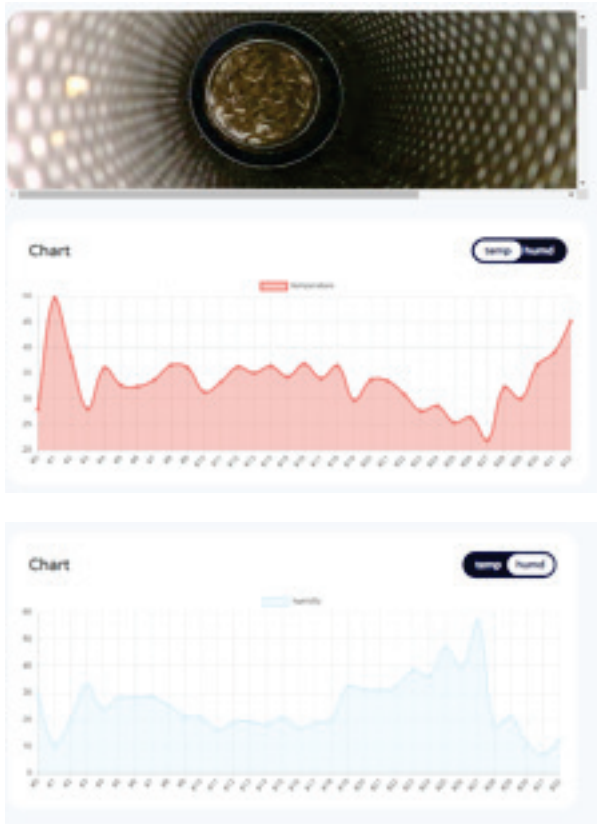
Installation Date: 4-27-2021





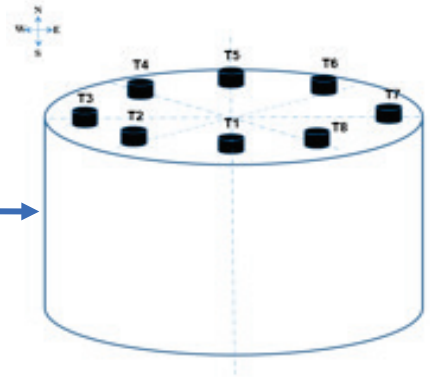


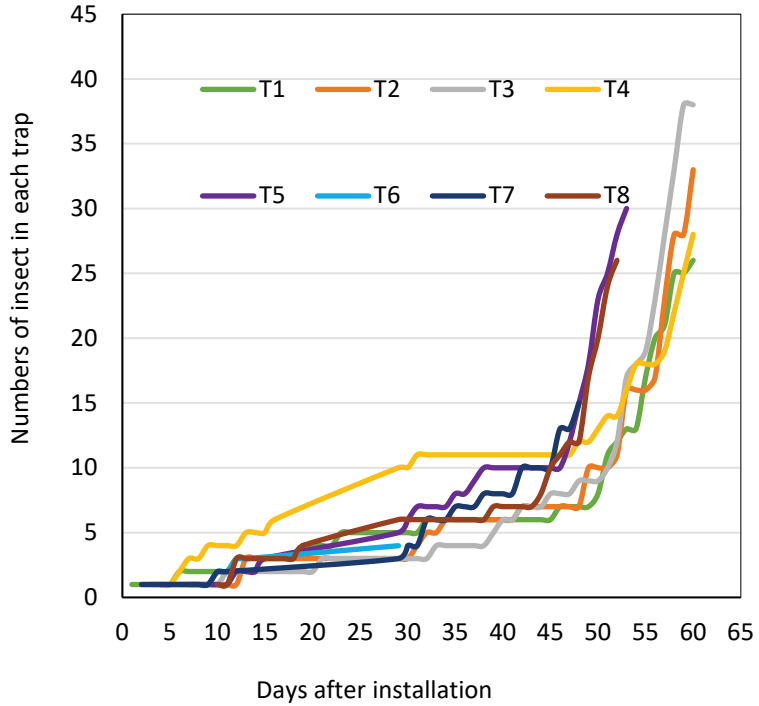


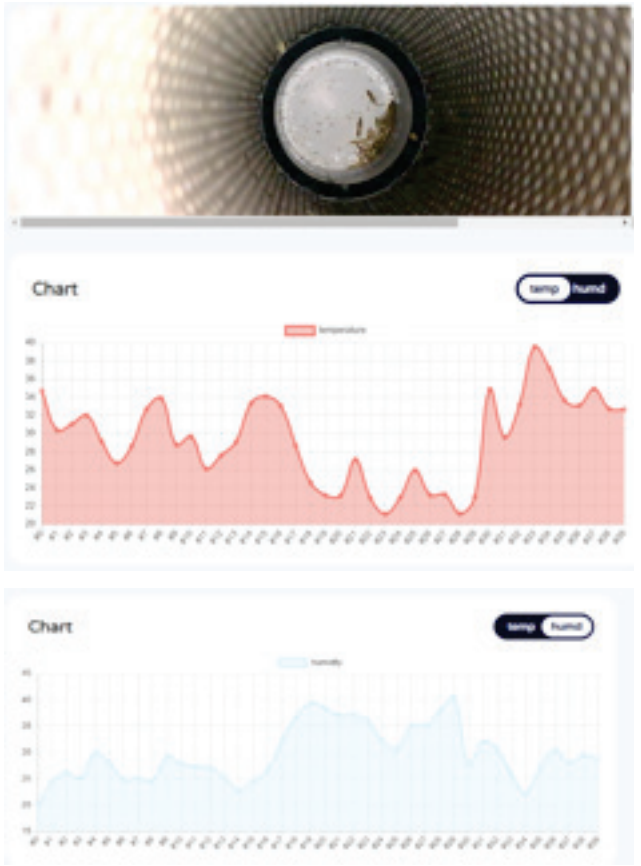


Warehouse #2

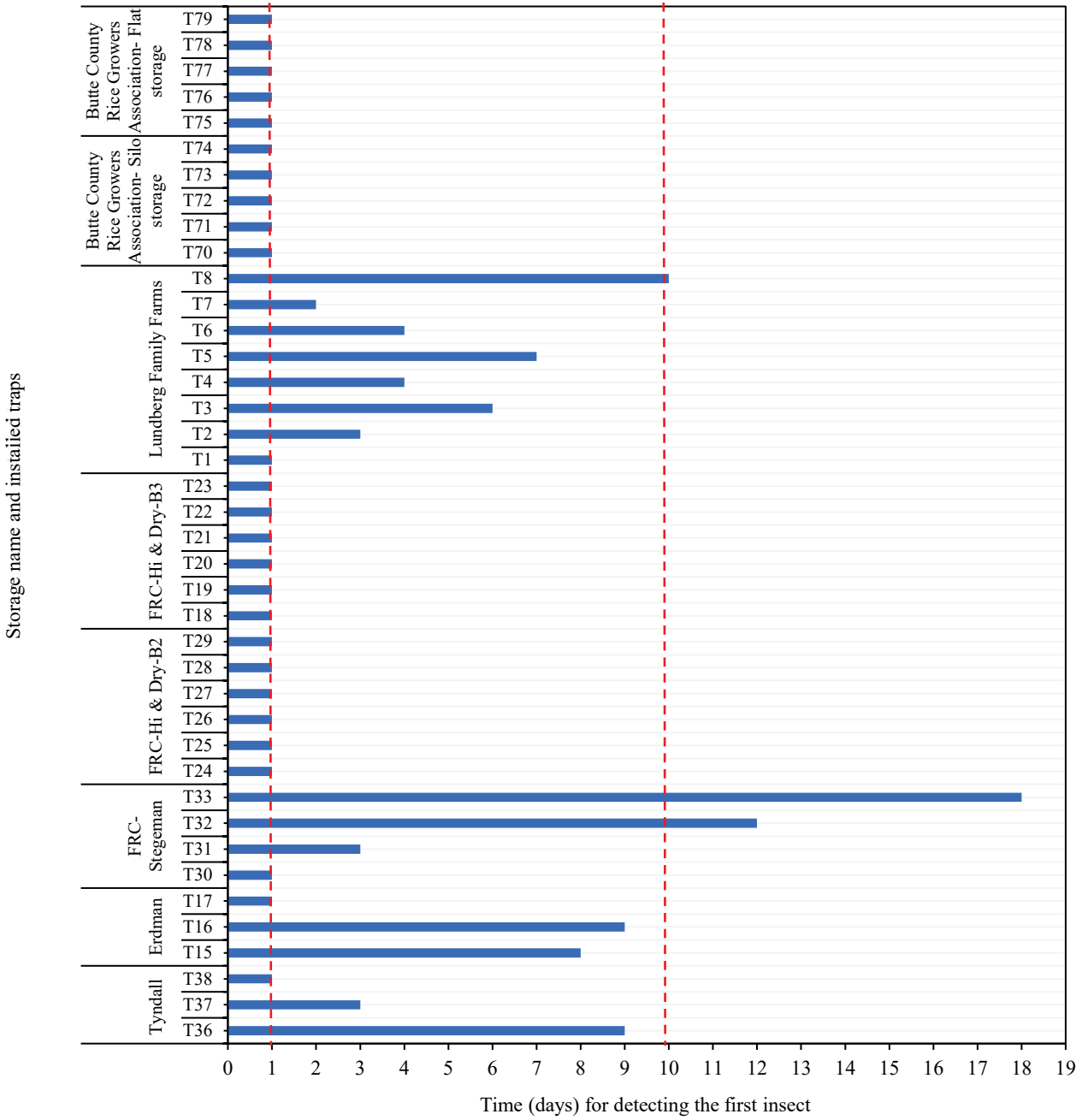
Installation Date: 4-28-2021







Early Detection Achieved

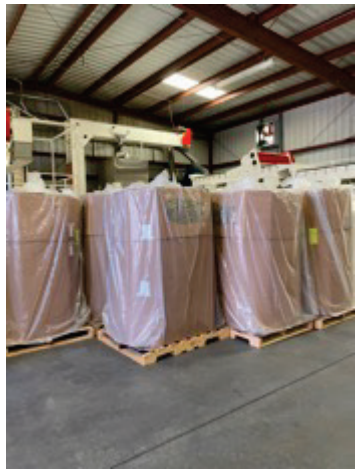


Commercial Cases: Almond Processors and Handlers

- Company #1
  - Rejected kernels in four bins
  - Stockpiled almonds – four stockpiles

Installed smart insect catching traps in stockpile

- Company #2
  - Almonds in carton boxes with and without plastic liner
  - Almonds in bins (2) with plastic liner, ready for final packaging
  - Rejected kernels in bins (2)



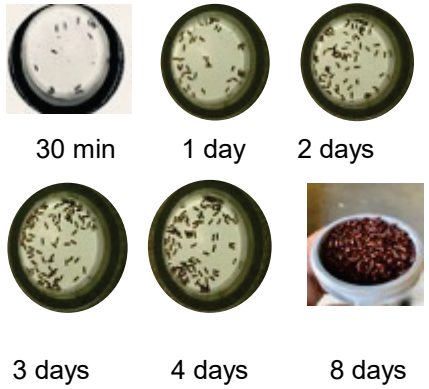
Company #1- Processing Facility

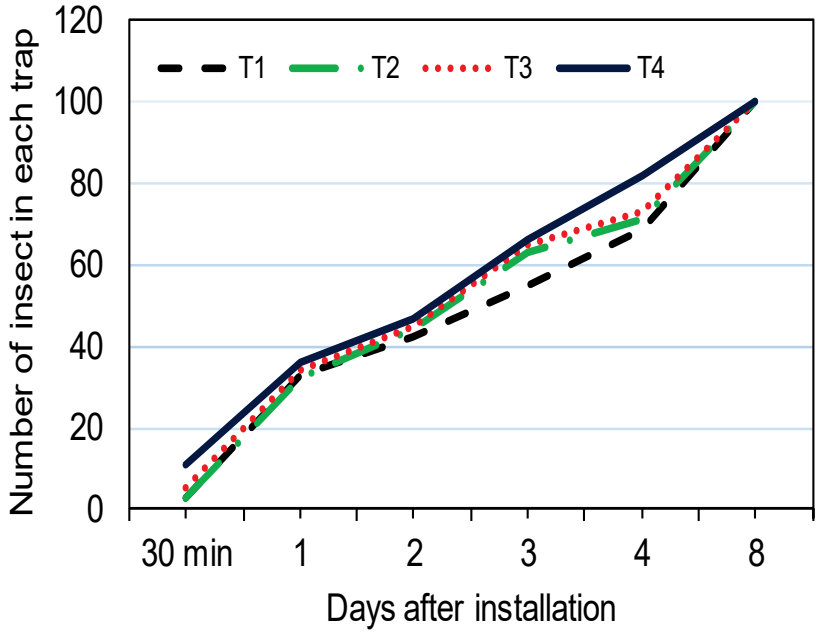
- Insects detected in traps installed in different bins of rejected almond kernels.
- Average temperature and relative humidity were in the range of 27.1±5.1ºC - 29.6±8.1ºC and 54.6±16.3% - 49.6±15.4%, respectively.

Container type	Product	Installation date	Uninstallation date	Traps no	Time detected the first insect	Final number of insects	Insect type
Wood bins	Rejected almond kernels	6/9/2021	6/17/2021	T1-Bin 1	30 minutes	Full (Too many to count)	Red flour beetles
				T2-Bin 2			
				T3-Bin 3			
				T4-Bin 4			

Smart insect catching device/trap

Trap 4 installed in rejected kernels





Company #1 - Handler

- Insects were detected in 5 of 6 devices after 1 week of installation for <u>stockpile #1</u>

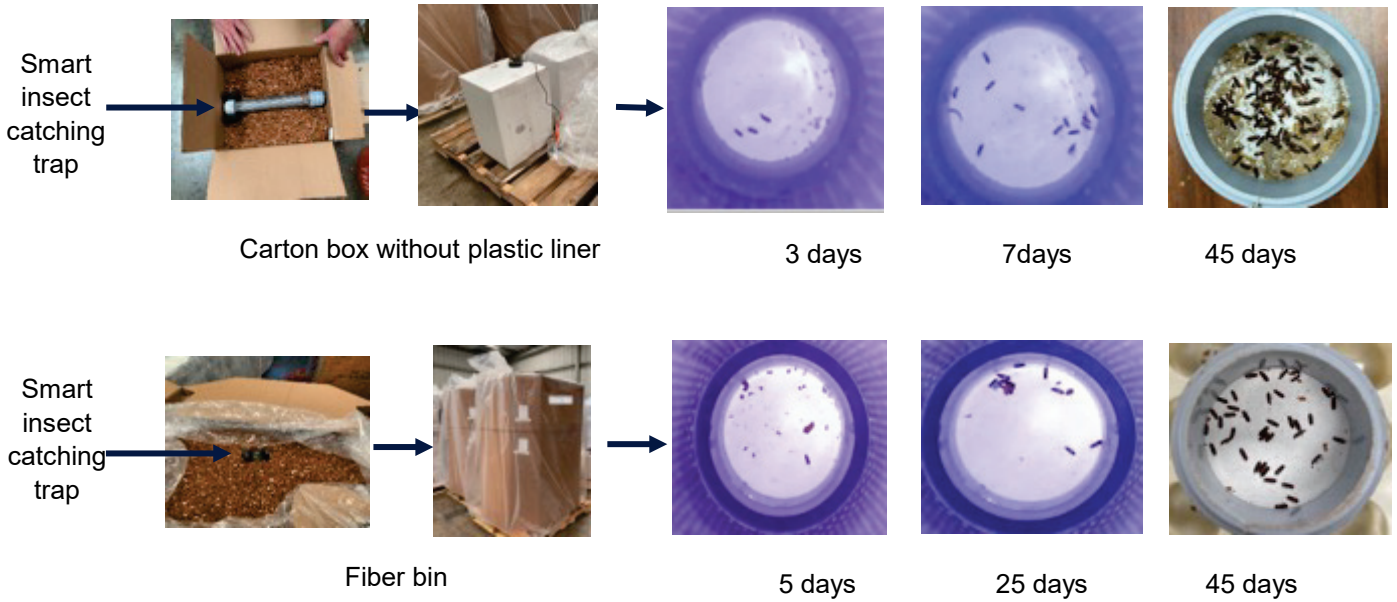
Installed smart insect catching traps in stockpile

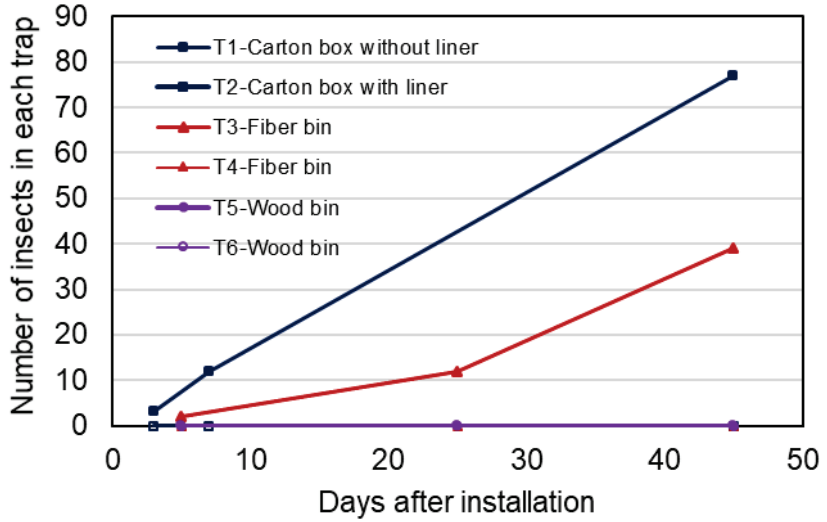
Trap No.	Installation date	Inspection Date					
		11/11/2021		12/2/2021		1/7/2022	
		Number of Insects	Type of Insects	Number of Insects	Type of Insects	Number of Insects	Type of Insects
T1	11/3/2021	1	Bug	2	RFB (died)	0	-
T2		1	Larva (NOW)	4	Moth (died)	0	-
T3		1	Bug	0		0	-
T4		2	Bug	0	-	0	-
T5		0	-	0	-	0	-
T6		2	Larva (NOW)	0	-	0	-

Fumigated on 11/11/2021 after inspection

Company #2 – Processing Facility

- Insect detection results
  - Detected in carton box without plastic liner, but no insect detected for the box with plastic liner.
  - In one of the two fiber bins.
  - No insects were detected in the two bins of rejected kernels.
- Average temperatures were 32.7±3.2ºC and 31.9±3.4ºC in the carton box without the plastic liner and fiber bin, respectively. The corresponding values of relative humidity were 41.8±4.8% and 40.7±5.7%.



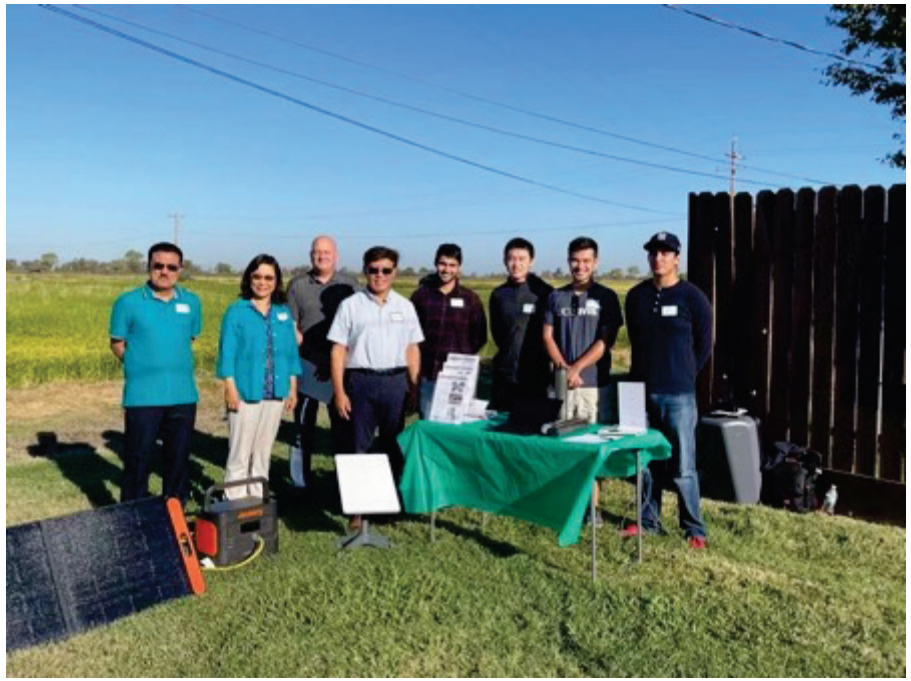


Successful Commercial Case: Walnuts

- IDC technology has successfully been demonstrated at almond and walnut facilities.
- Insects were detected with the IEDC technology, but not by human inspection.

Support by Industry and Organizations

Thank You



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