

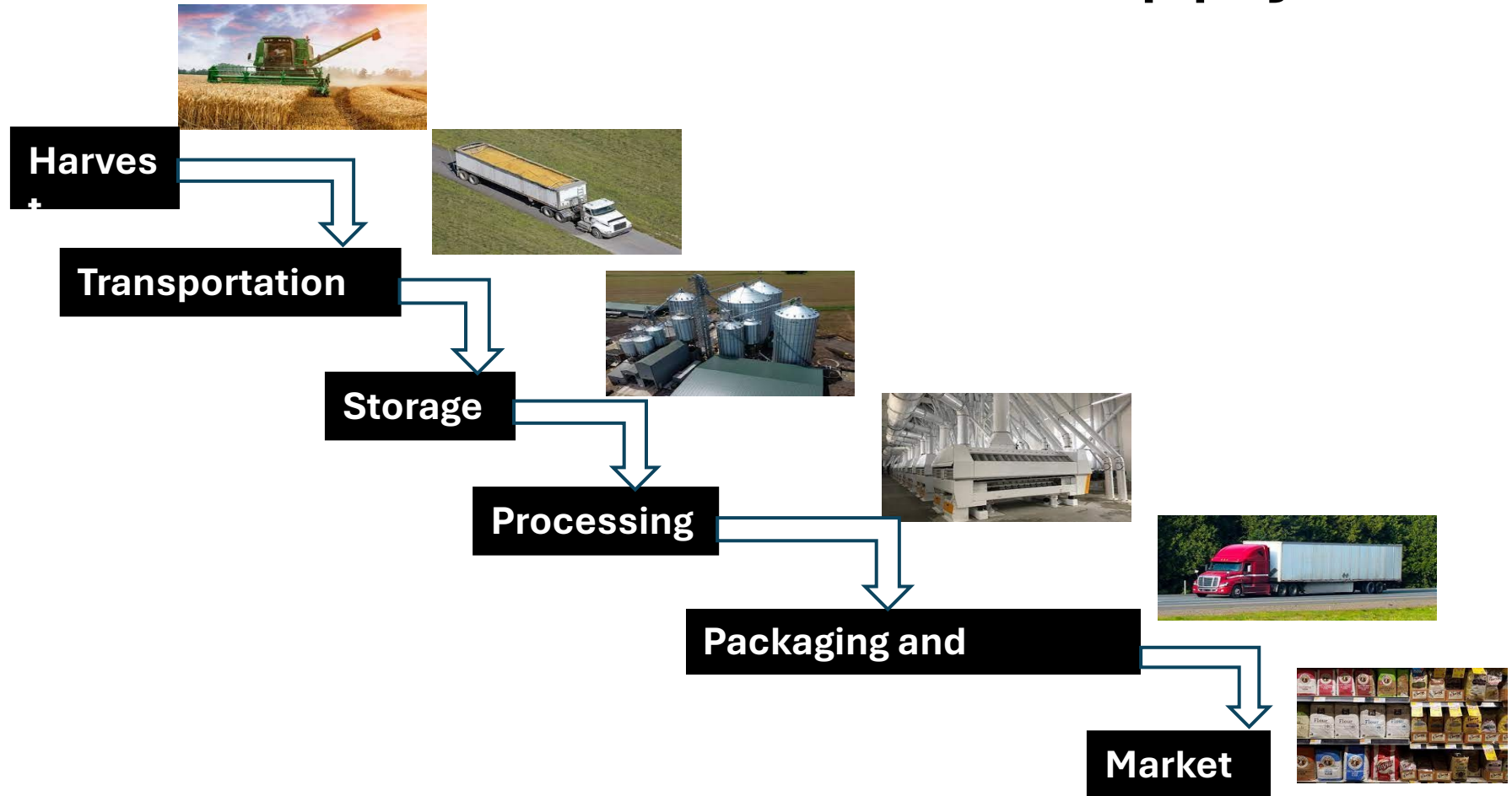
# The Role of IPM and Postharvest Science in Agricultural Innovation

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Agricultural Research Service  
U.S. DEPARTMENT OF AGRICULTURE

# Post-Harvest Supply Chain

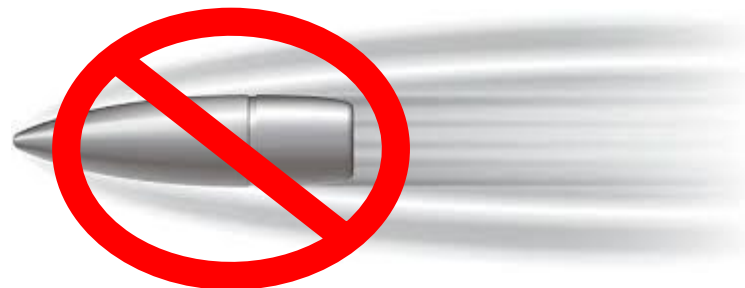


# Integrated Pest Management (IPM)

- Holistic science based decision-making process that uses **biological, physical, and chemical** tools to **identify, manage, and reduce** risks from pests to maintain overall safety
- Use the best available pest management tools, techniques, and strategies to minimize
  - Economic risks
  - Health risks
  - Environmental risks



# Premises of IPM



1. Long term protection
2. Avoid total dependence on chemical pesticides
3. Try for a combination of controls → multi-hurdle approach
4. Ecosystem based decision to be environmentally sensitive
5. Surveillance and monitoring
6. Use a targeted treatment



# Where are the insects?

- Most stored product insects do not infest grain in the field
- Infestation of newly stored grain can occur within days or weeks
- A large community of insects are associated with milling, food processing, and storage facilities
- Insects can be observed and captured
  - Grain storage bins and elevators
  - Milling and food processing facilities
  - Infesting grain spillage



# Why Sanitation Matters?

- 2 locations in Arkansas
- Placed 4-5 screens on “natural” spillage around the facility
- Sampled from June – October
  - Placed screens out for ~48 h
- Collected and tabulated
  - Number of insects on top and bottom
- Conducted in 2015 and 2016



# Testing Locations





Lesser Grain Borer



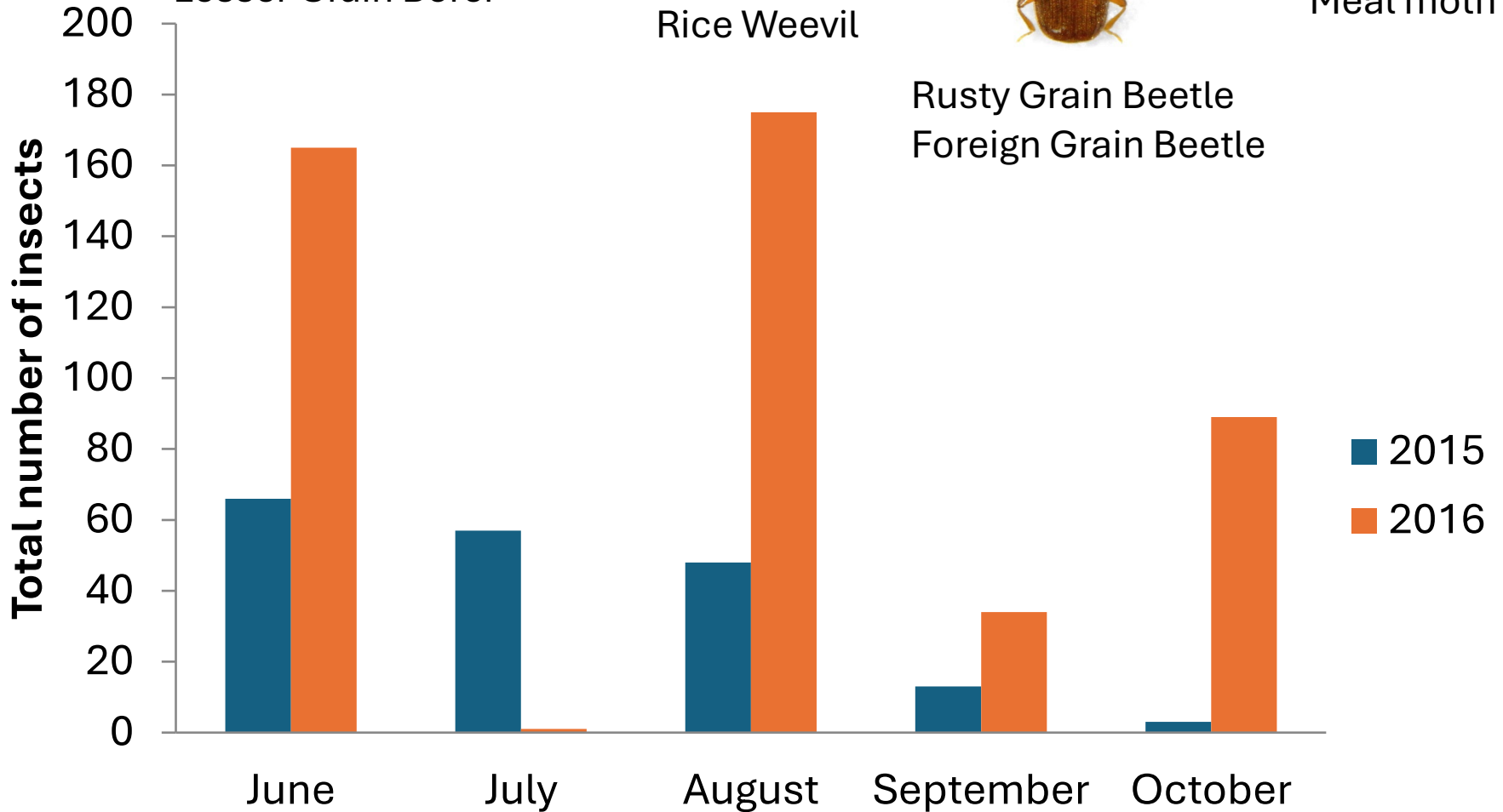
Rice Weevil



Rusty Grain Beetle  
Foreign Grain Beetle



Meal moth



# What can we do?

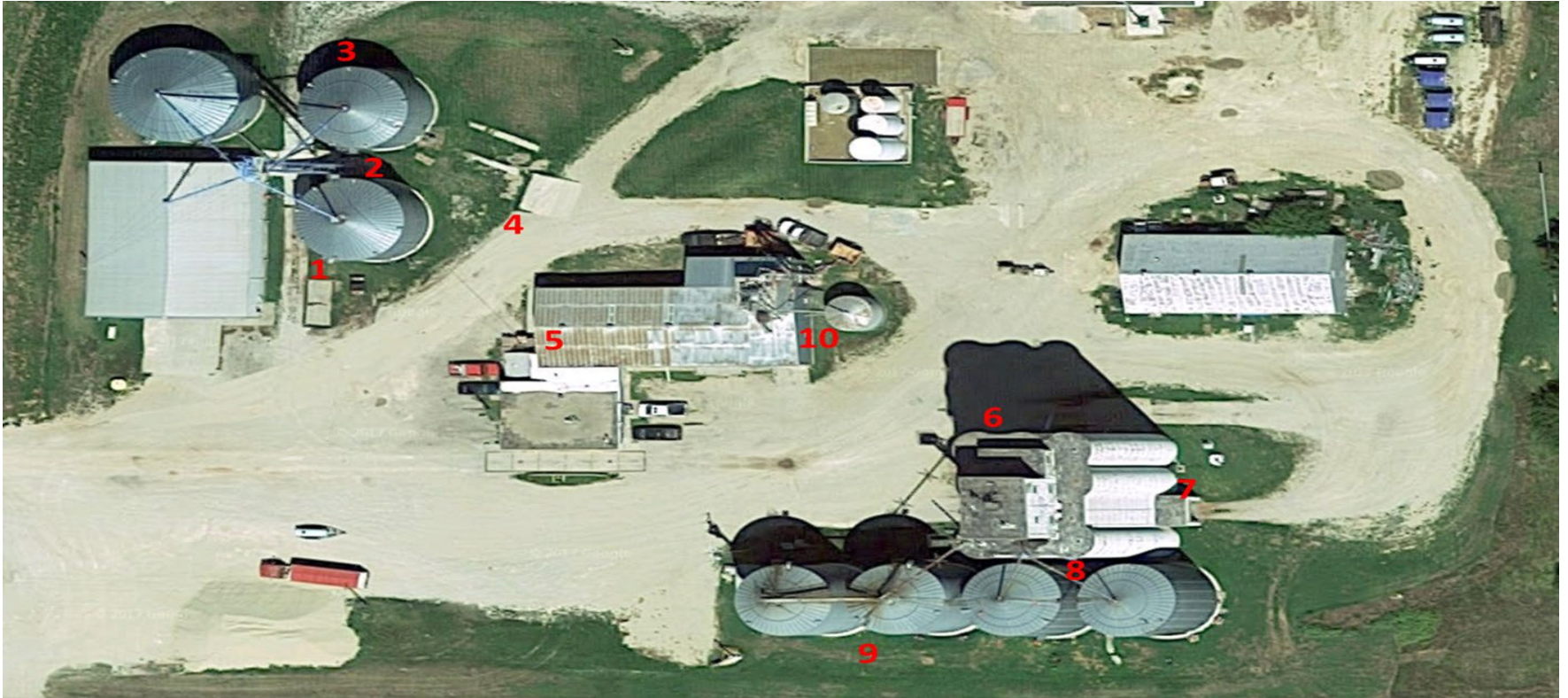
- 50 g lots of crimped wheat
- Grain Protectants
  - Deltamethrin (Centynal)
  - $\beta$ -Cyfluthrin (TempoSC)
  - Water (control)
- 3 different locations
  - Traps deployed for ~48 hrs
- Collected and analyzed
  - Species of insects
  - Progeny production



# Facilities

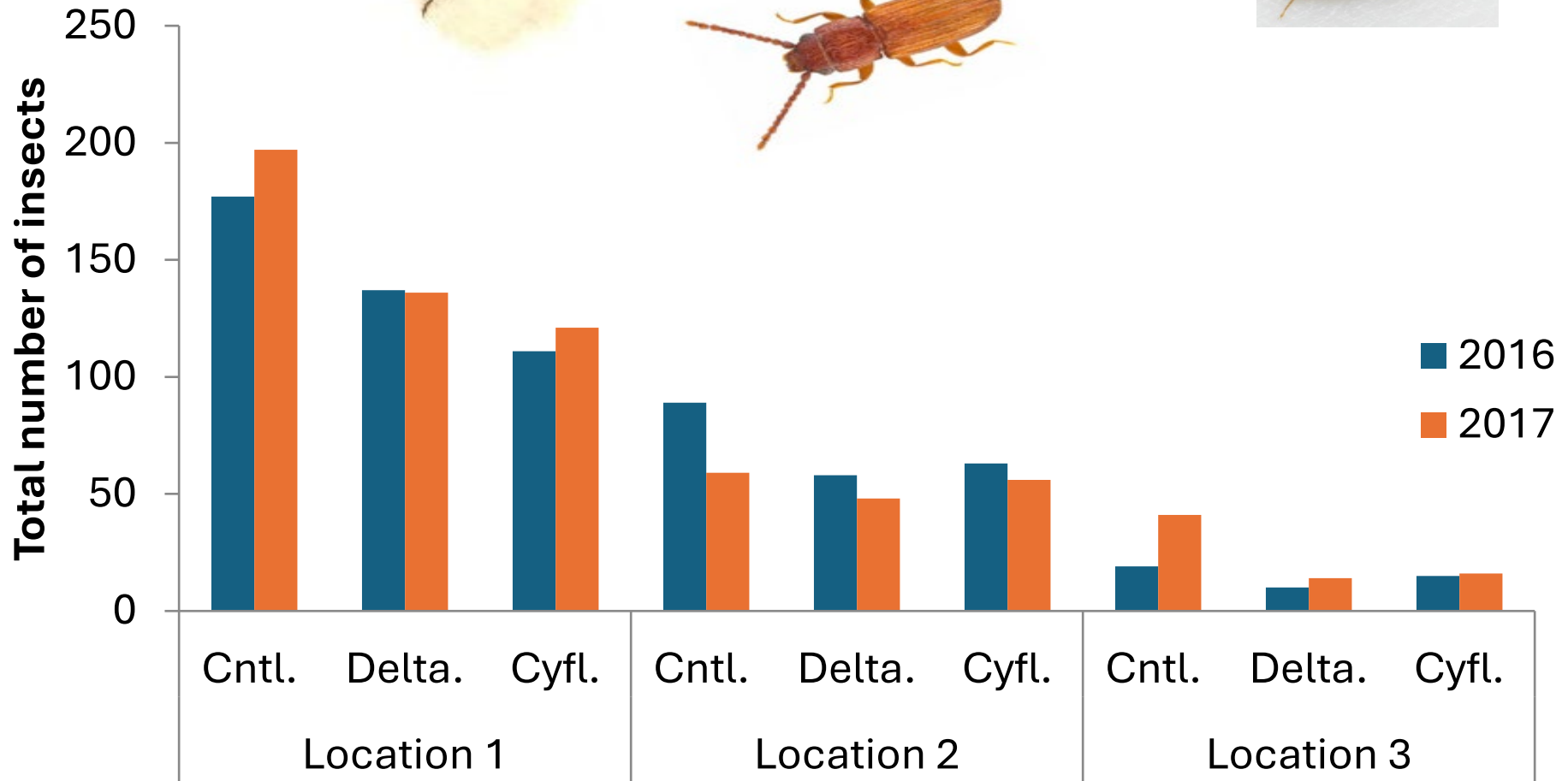


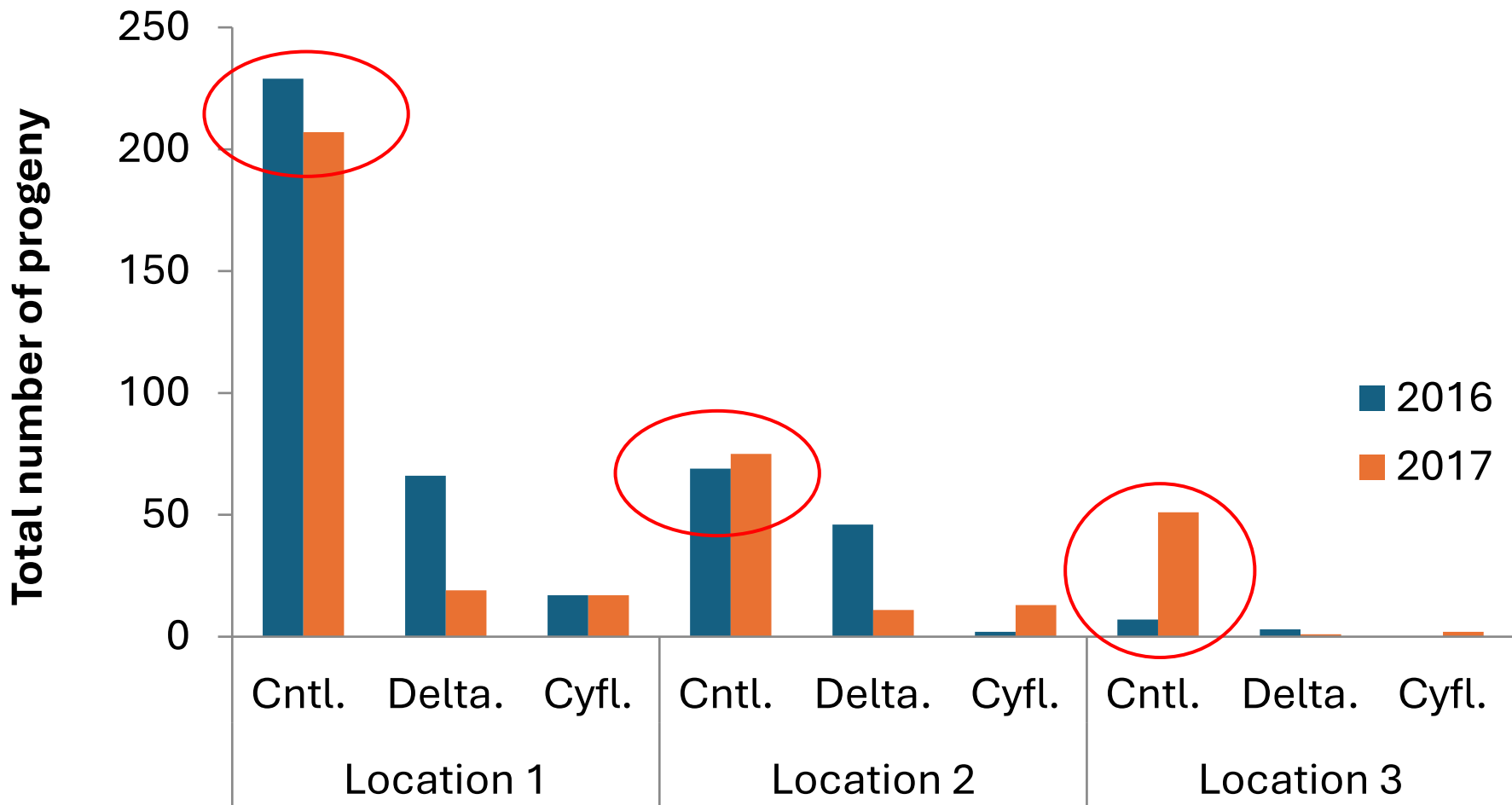
# Facilities



# Facilities







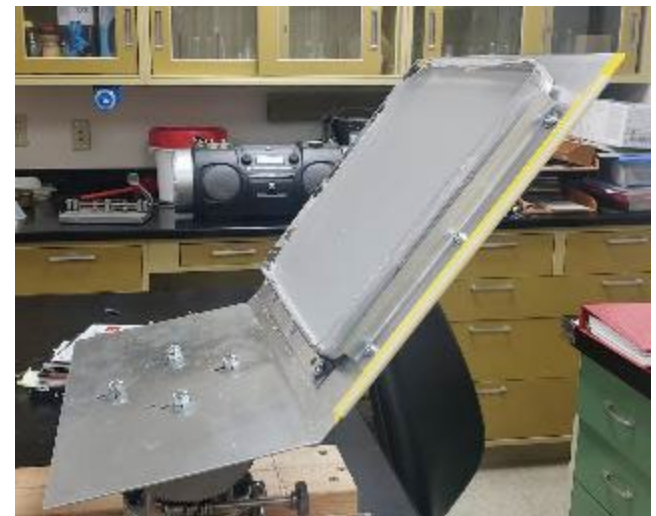
# Summary

- Insect can infest new spillage or grain in < 48 h
  - Treated and untreated grain
- Insect are capable of laying eggs in < 48 h
  - Fewer progeny produced in the treated grain



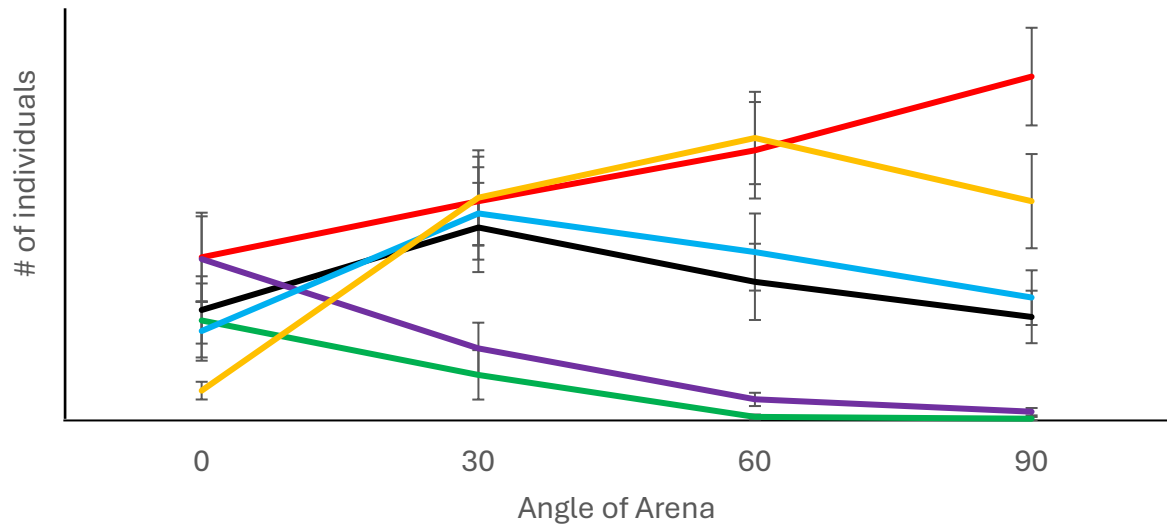
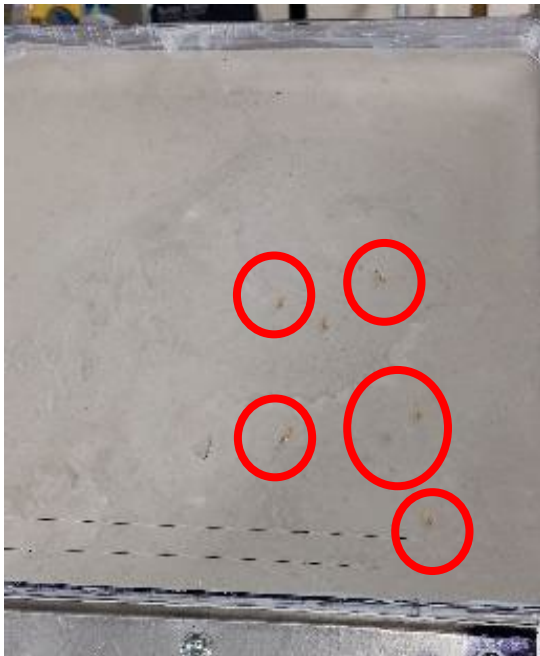
# Investigating Insect Mobility

- Investigating climbing ability of stored product insect adults and larvae
  - Evaluating several common surfaces found in mills, warehouses, storage facilities, etc.
  - Aide in trap designs and improvements to existing traps and their placement
  - Insight into facility design choices



# Invasive Species – Khapra Beetle

Angle and type of material significantly influences larval movement!!



— Rockite — Painted — SheetRock — Metal — Tile — Wood

# Sawtoothed Grain Beetle (STGB)

- Cosmopolitan stored product insect
- Feed on slightly damaged grain vs. whole grain
- Full life cycle <10 wks
- Use traps for monitoring

**Objective:** Do STGB have a preference between two common insect traps?

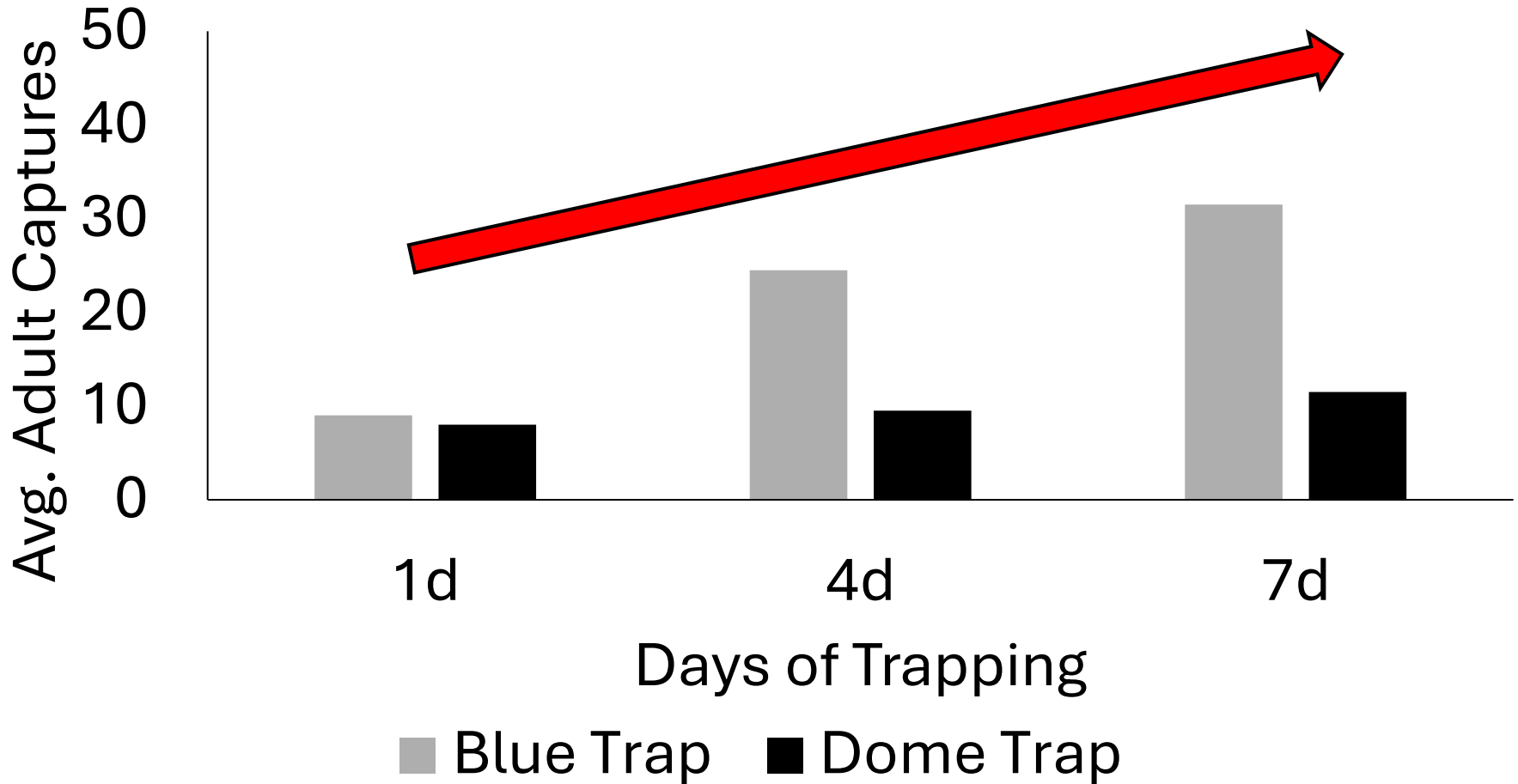
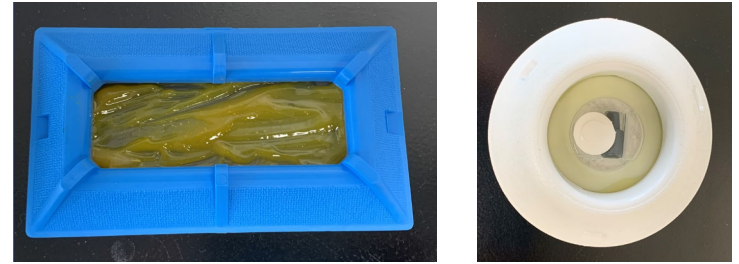


# Methodology

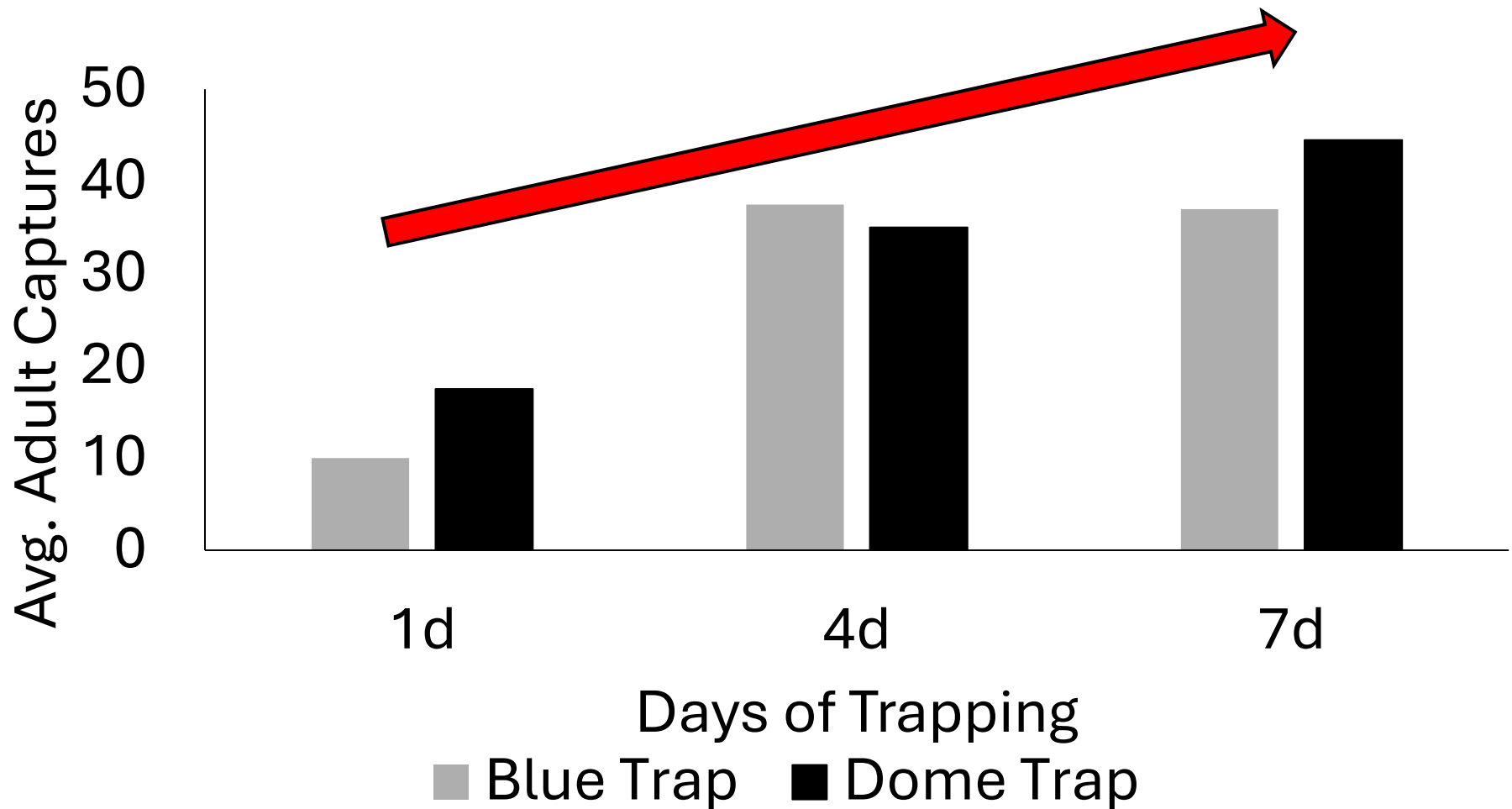
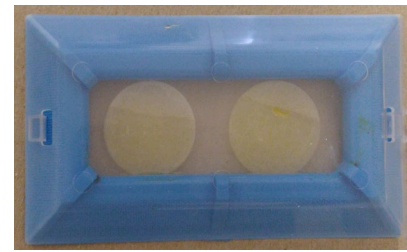
- Experimental Shed
  - 2.8 × 5.90 m (W×L)
- Blue Trap and Dome Trap
  - Standard bait
  - Swapped bait
- Released 200 adults
- Observations (cumulative)
  - 1, 4, and 7 days



# Standard Set-up



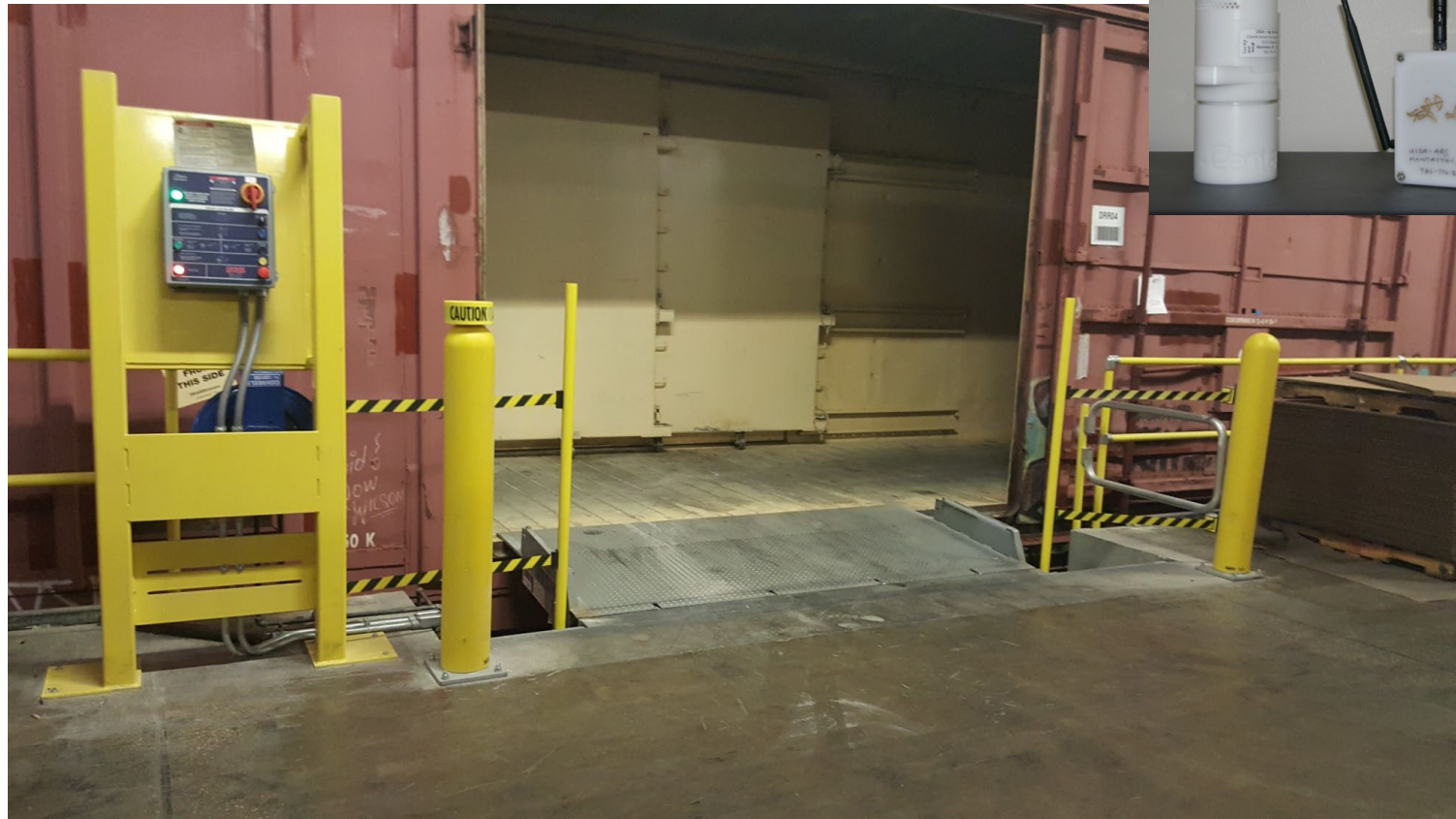
# Alternate Set-up



# Next Steps...Trap Improvement and Automatic Detections



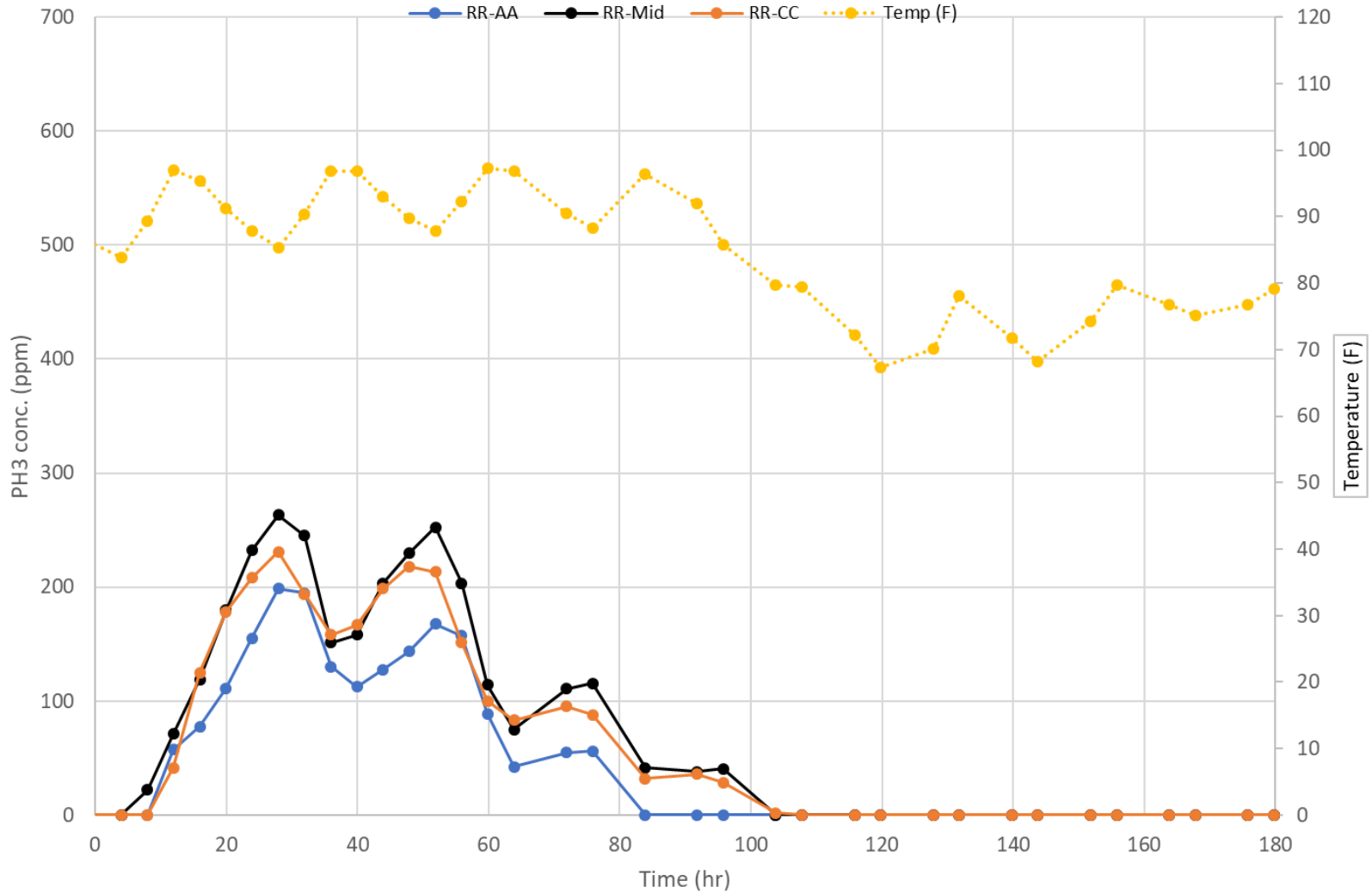
# Evaluating Advances in Gas Sensor Technologies



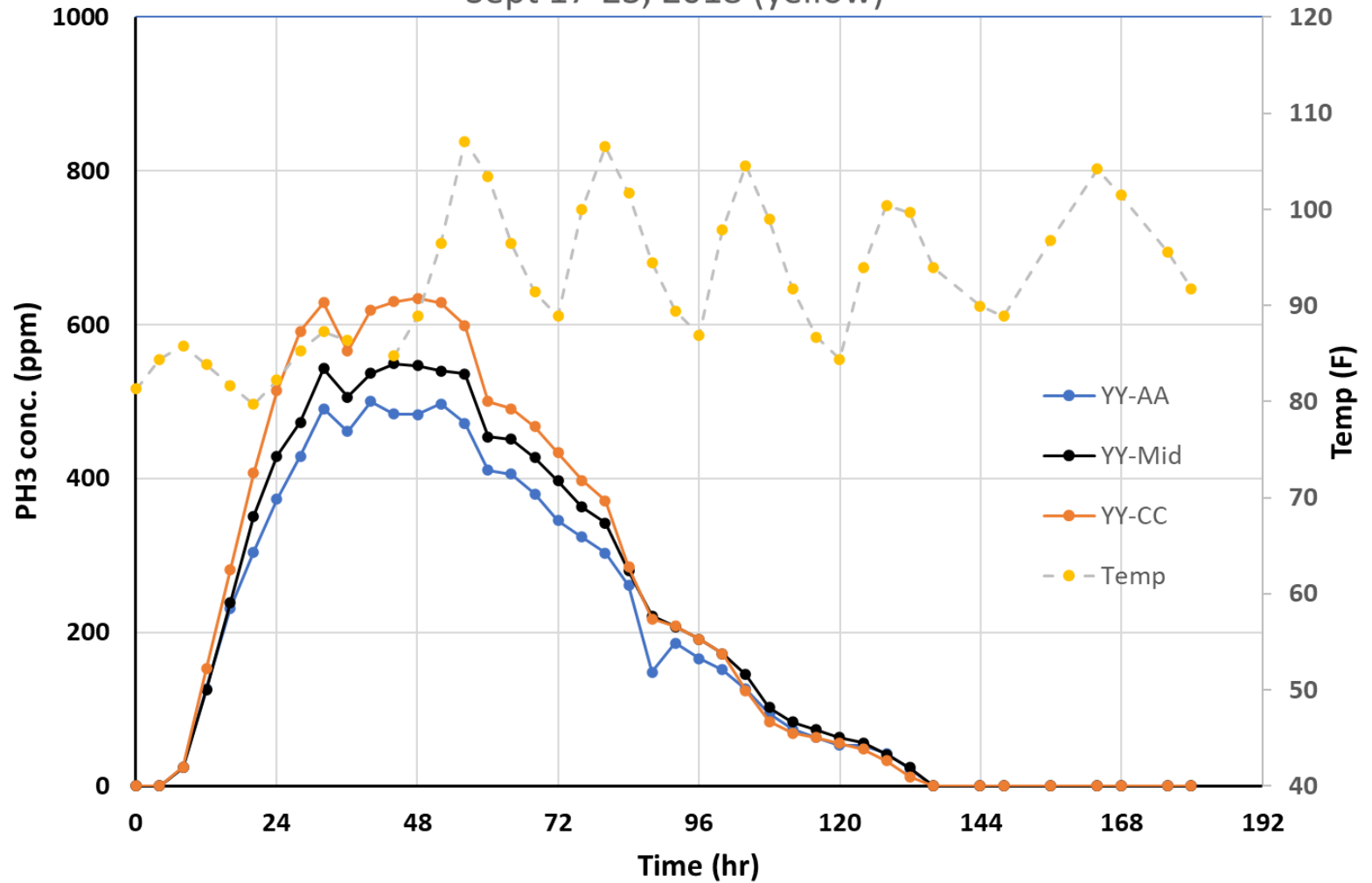
# Railcar Fumigation Studies



Trial #03-rr Railcar Fumigation Monitoring  
Sept 17-23, 2018 (red/gray)

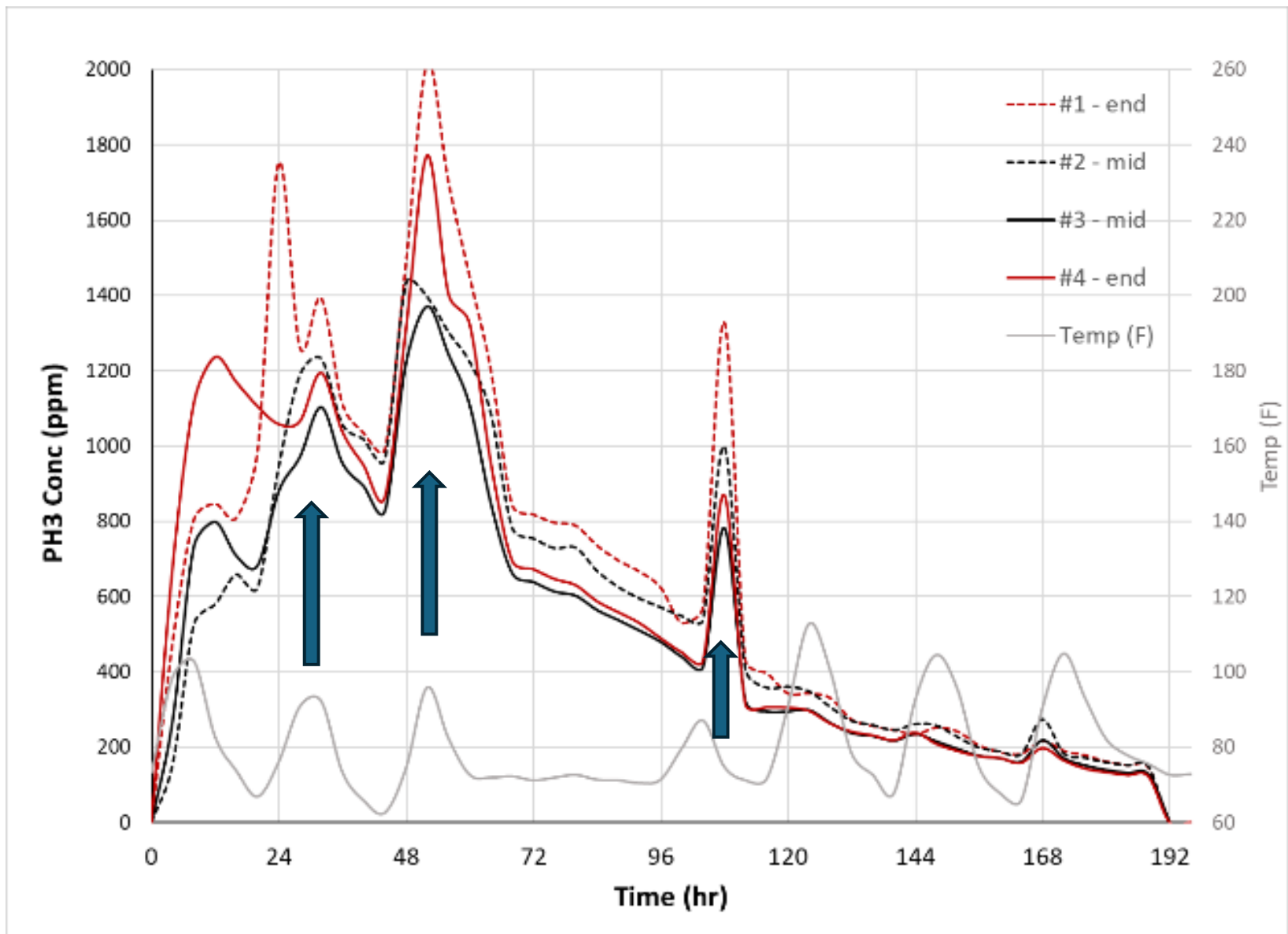


# Trial #03-yy Railcar Fumigation Monitoring Sept 17-23, 2018 (yellow)

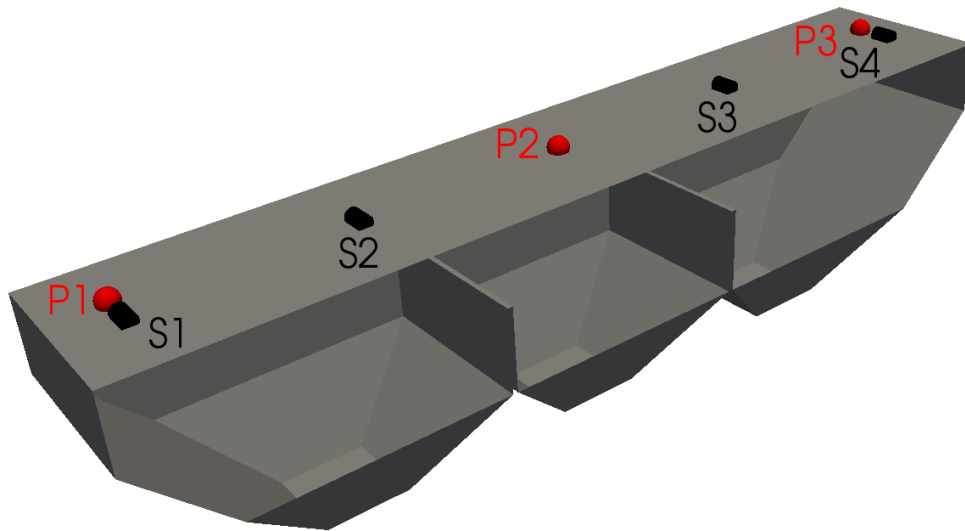


# Corn Grits Fumigation





# CFD Model for Gas Distribution

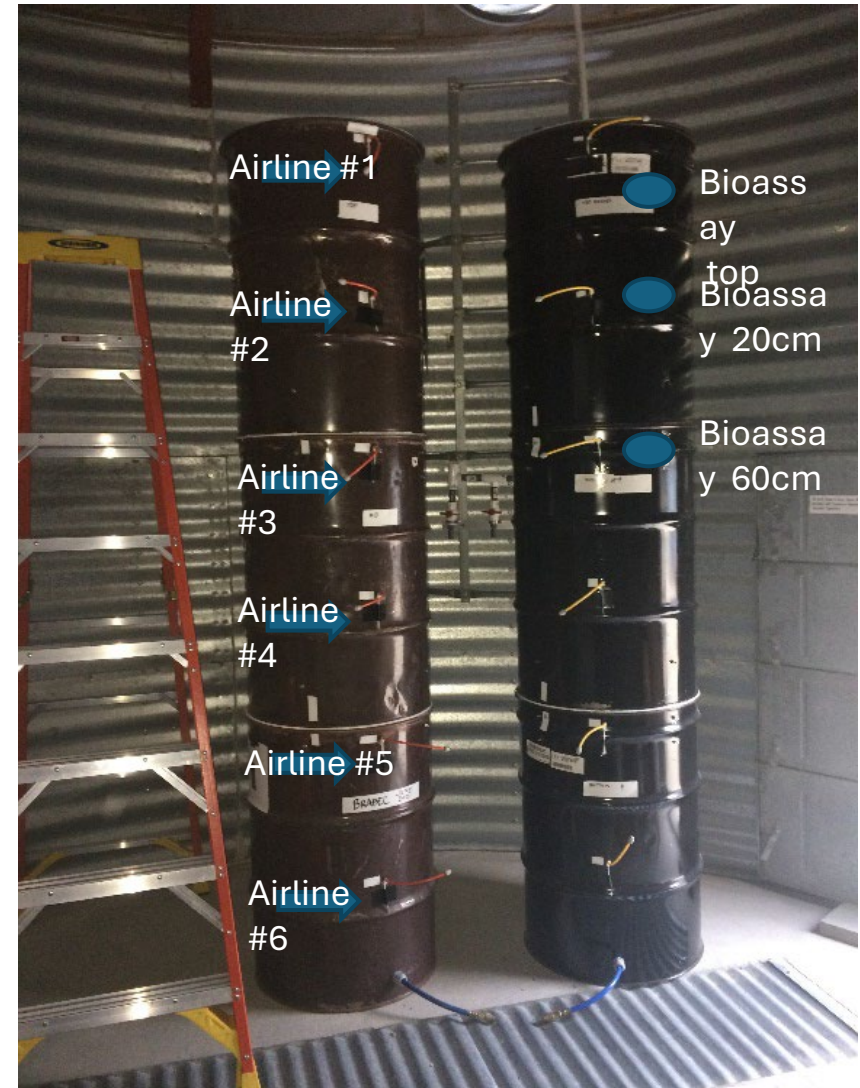


CAD drawing of railcar  
used in CFD modeling

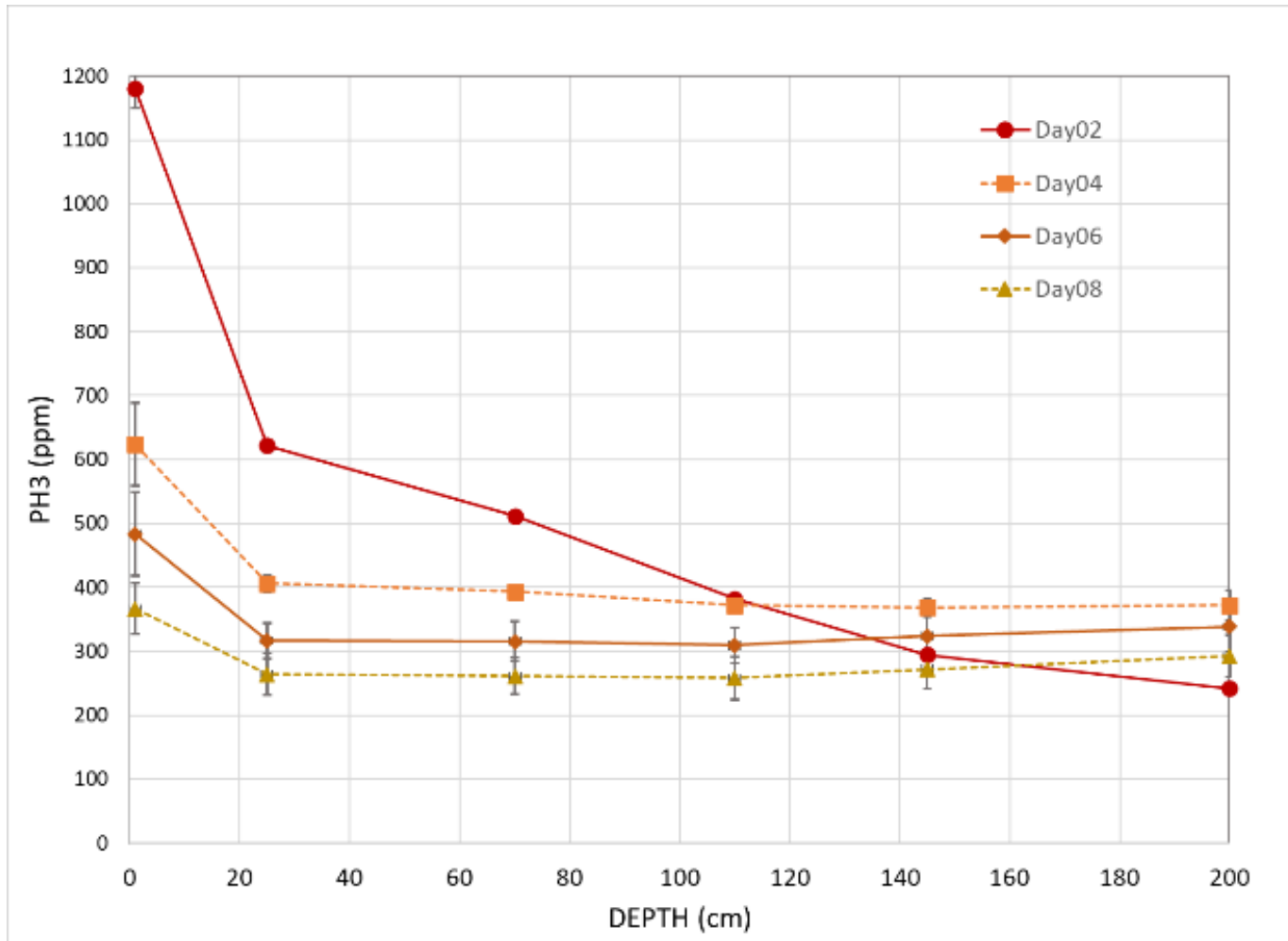
- <https://youtu.be/b0p20S9zbXg>

# Insect Bioassays

- How does the fumigant distribute vertically through stack of corn grits?
  - Gas readings
  - Insect bioassays



# Vertical Gas Distribution



# Summary

- The gas sensors are a great tool to monitor fumigations
  - Monitor several key factors in grain quality (not shown)
- Sensor readings are comparable to readings from gas lines
- Require a gateway and program to relay data
  - If they are not co-located, data can be downloaded later
- CFD models are a great tool to demonstrate and predict gas distribution



# Next Steps...Container IPM



# Container Fumigation Prediction

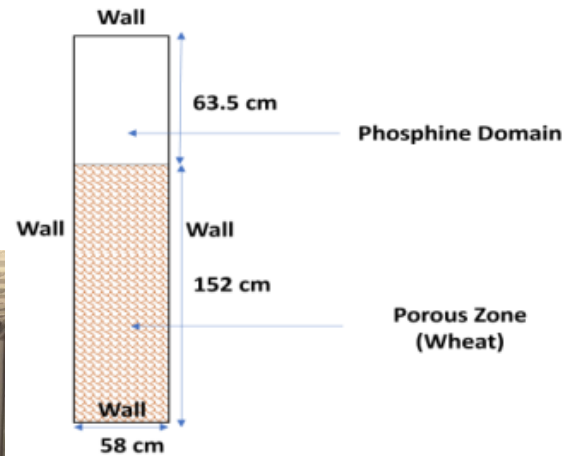


Figure 1. Sketch of the 2D Barrel in CFD model

# Grain Protectants

- Initial efficacy and sub-lethal effects of four different grain protectants
  - Evergreen<sup>®</sup>, Sensat<sup>™</sup>, and Centynal<sup>™</sup>
- Treat grain, hold for 7 d, and transfer to untreated or treated grain
- Mortality results: Sensat<sup>™</sup>
  - Cntl → Cntl = 0% initial, 0% transfer
  - Cntl → Sensat = 6% initial, **96% transfer**
  - Sensat → Cntl = 68% initial, **98% transfer**
  - Sensat → Sensat = 84% initial, **100% transfer**

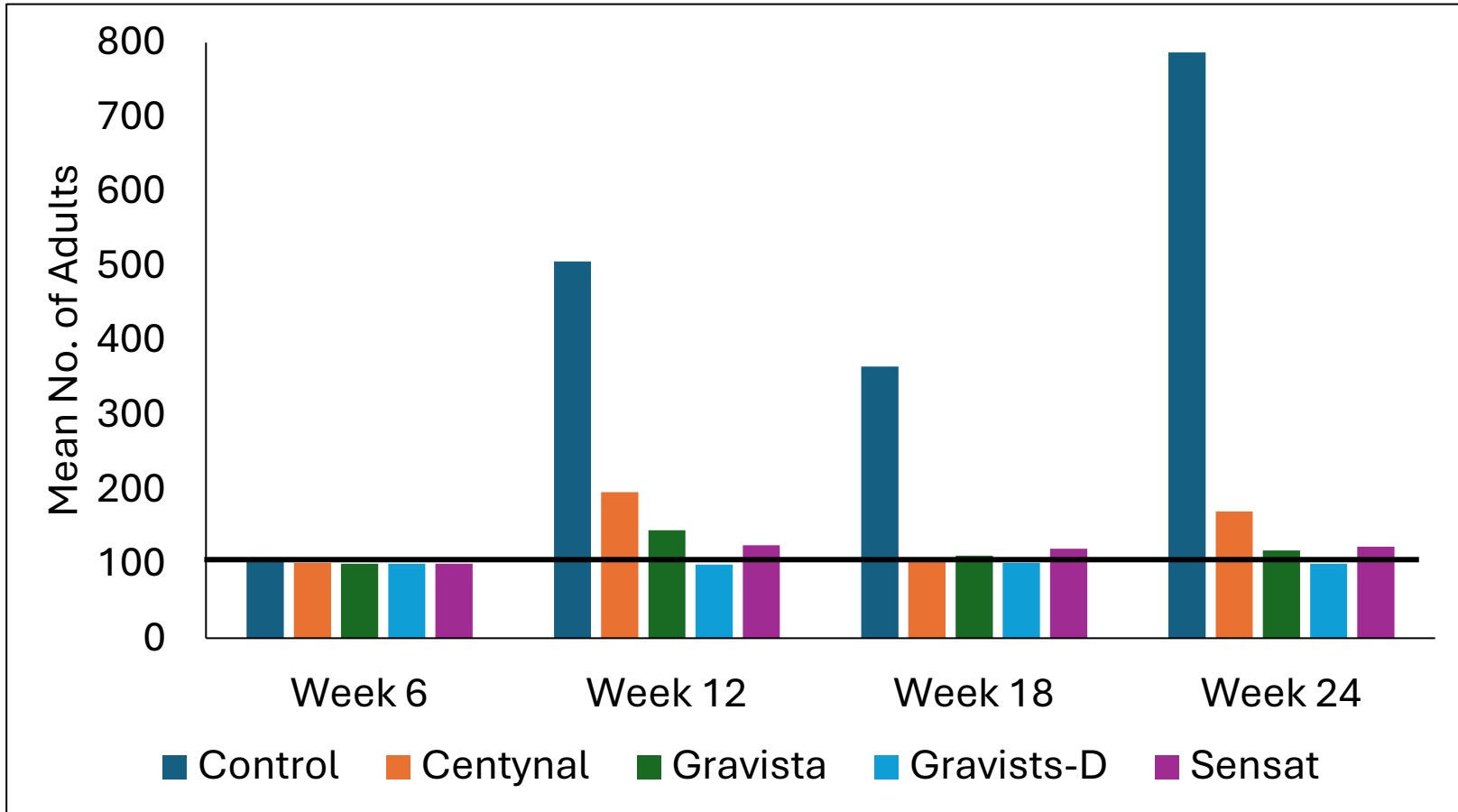


# Grain Protectants

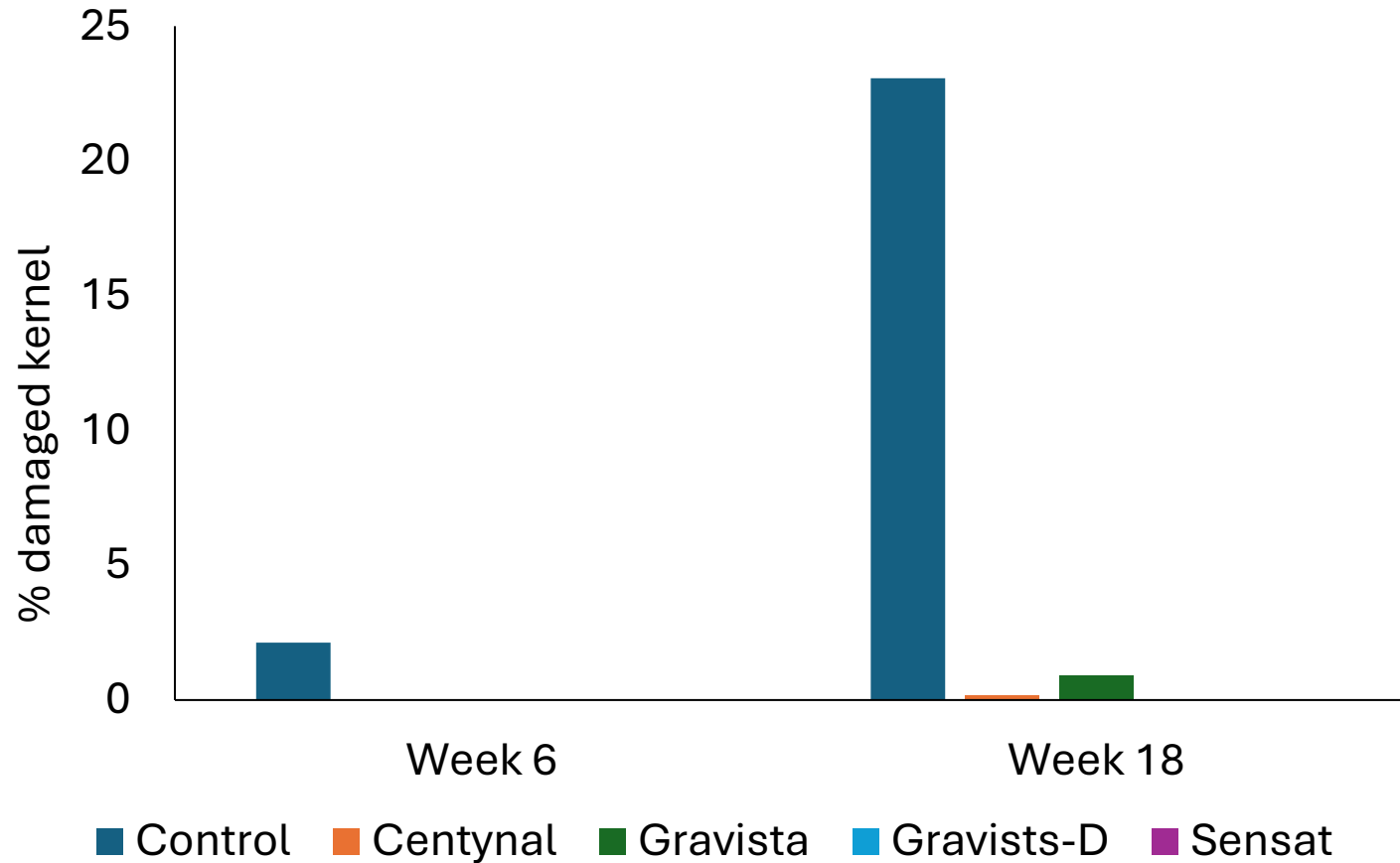
- Treat grain, infest with rice weevils, and hold for 6, 12, 18, and 24 wks of storage
- Determine
  - Infestation level
  - Weight loss
  - Damaged kernels



# Grain Protectants



# Grain Protectants



# Next Steps...Semi-Field Studies and Movement Through Grain



# Semi-Field Studies



# Example of Insect Monitoring



Grain Protectants



Fumigation

Sanitation

Trapping

Pre-container applications



Mating  
Disruption

Packaging

Aerosol/Fogging



# Questions and Comments!

## Contact information

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