



# Heat Treatment of Empty Metal Storage Bins

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# Outline



- \* Project Overview
- \* Objective
- \* Equipment and Process Used
- \* Temperatures and Insect Mortality Results
- \* Conclusions
- \* Future Plans



# Introduction



- \* Residual chemicals currently recommended for pre-binning sanitation
- \* Heat treatments have been successfully applied in processing facilities to control insects (alternative to Methyl Bromide)
- \* Bins with full drying floor particularly difficult for sanitation
- \* GMPRC Pilot Plant had a bin needing sanitation

# Project Overview

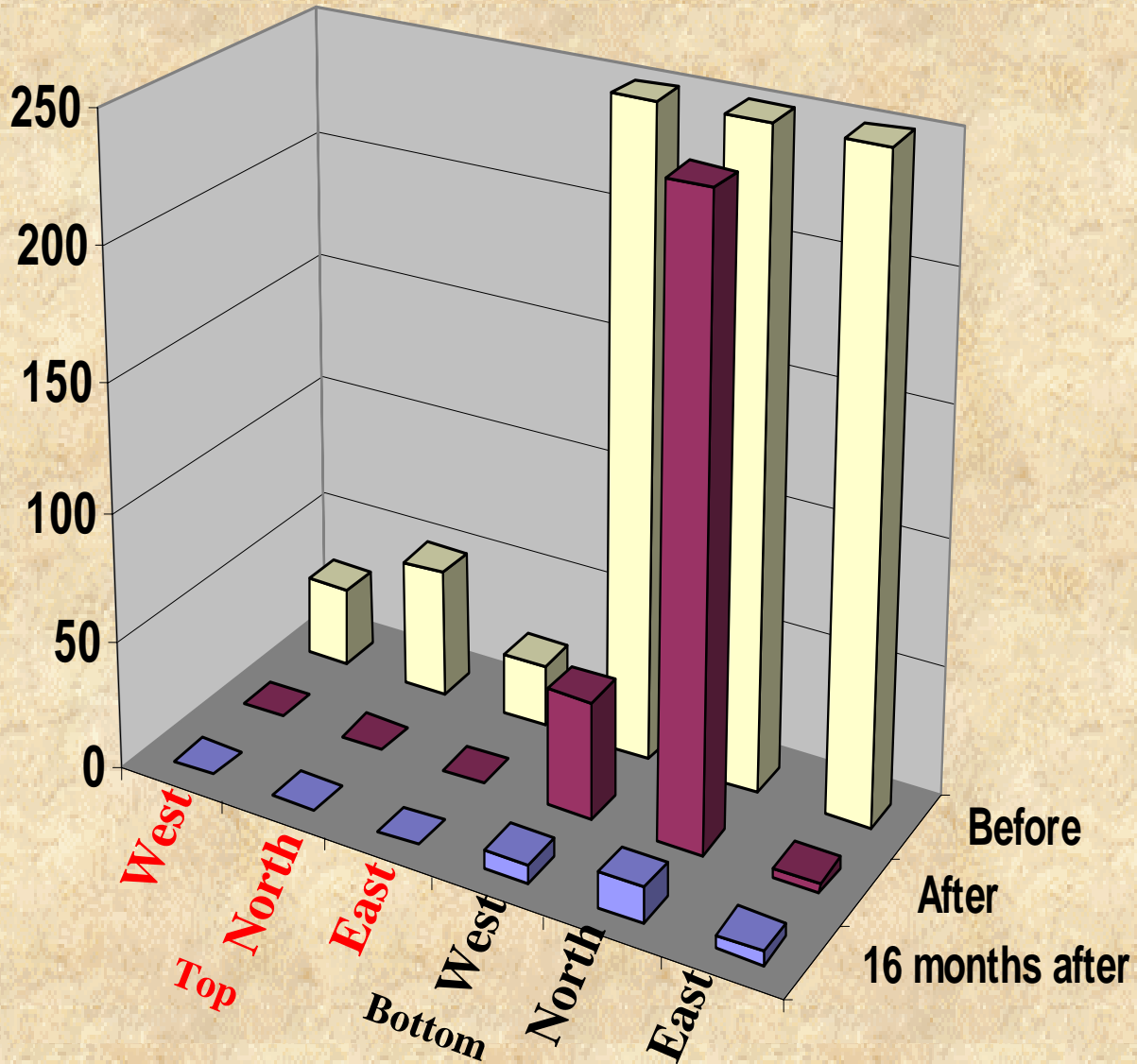


- \*4,000 bu metal drying bin (perforated floor).
- \*Large variable speed drying fan.
- \*1 h.p. aeration fan for circulation in the bin.
- \*Perforated floor was covered with tarp.
- \*Introduced live insects to check mortality.



# Trap Counts

Number of  
Insects



# Larvae Exiting Bin



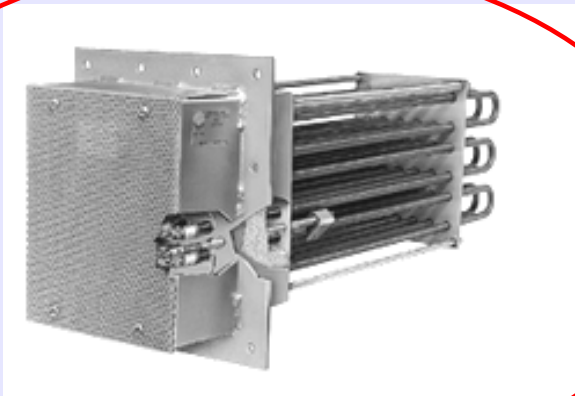


# Project Objectives



- \* Develop a practical method to obtain a uniform heat distribution of 120°F within the bin.
- \* Evaluate insect mortality rates.
- \* Develop an economic model describing the most cost effective method of using heat to sanitize steel grain bins prior to filling.

# Heating Equipment



Duct Heater

**18 kW or 61,400 BTU**



Forced Air Propane Heaters

65,000 - 85,000 - 100,000 BTU



# Three species added to arenas'



Rice weevil  
(*Sitophilus oryzae*)



Red flour beetle  
(*Tribolium castaneum*)



Lesser grain borer  
(*Rhyzopertha dominica*)

# Arena

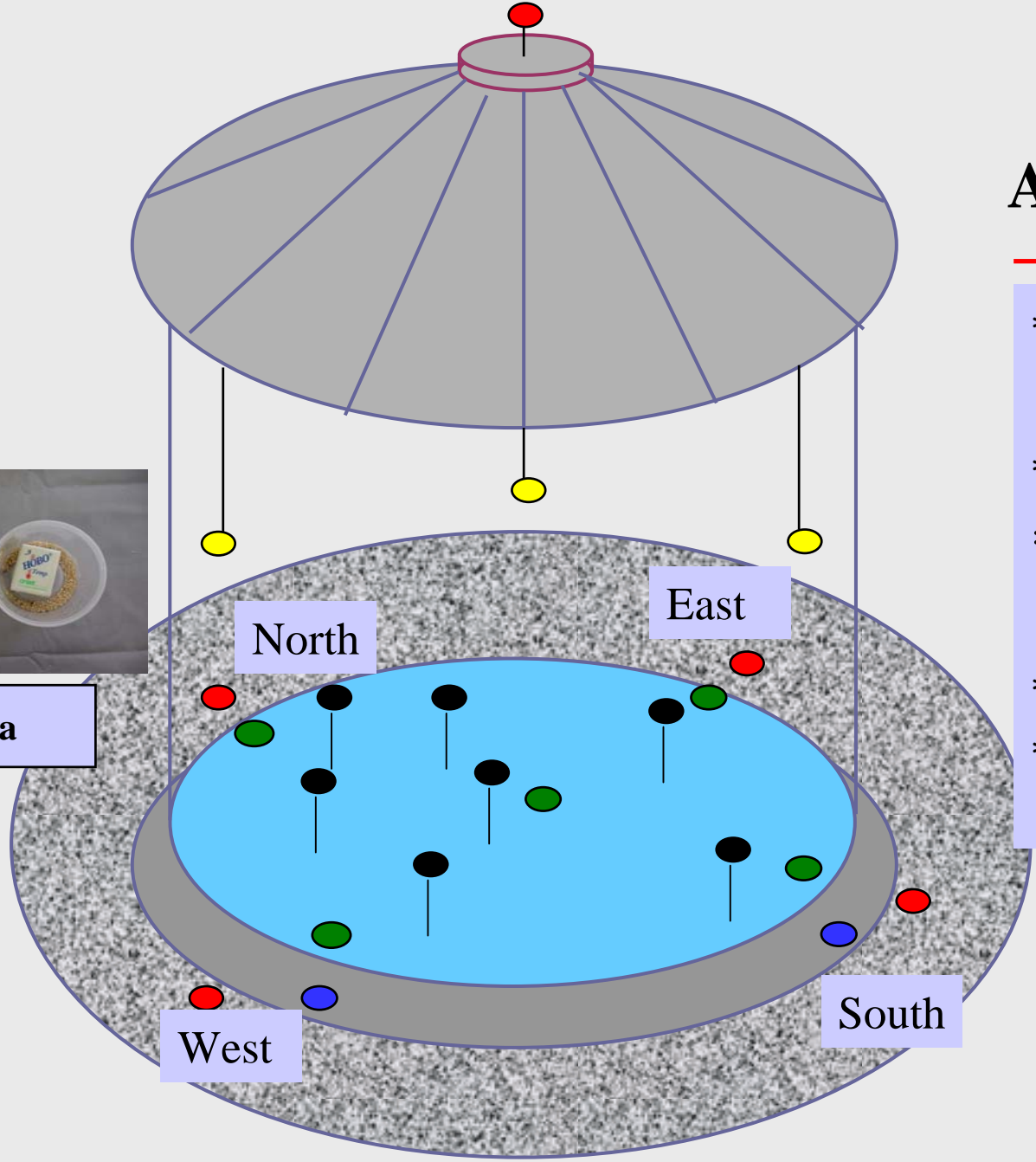
- \* 3 species of insects.
- \* HOBO Temperature Instrument.
- \* 1 tsp of cracked wheat





# Arena Locations

- \* **5 Control located outside of bin..**
- \* **5 Below aeration**
- \* **5 Above Aeration floor**
- \* **7 One foot above**
- \* **3 Upper Portions of bin**



North

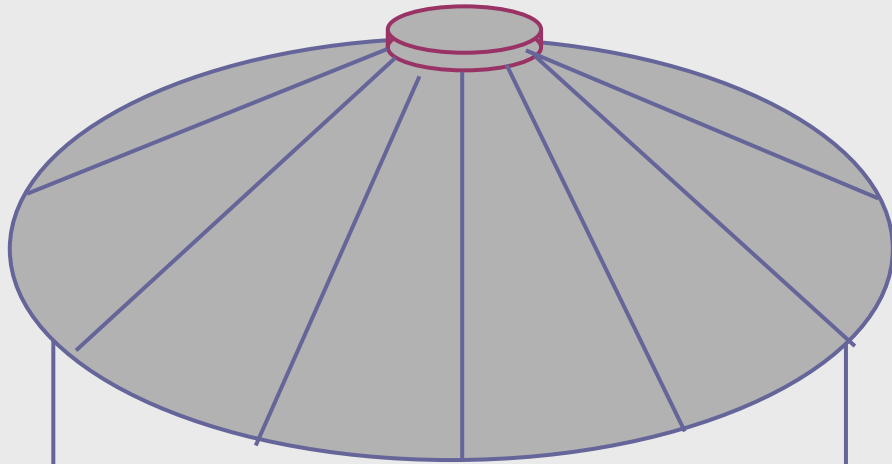
East

South

West



Arena



Electric Duct Heater  
**Length of tests:**

- 12 hr
- 27 hr
- 40 hr



**Arena**

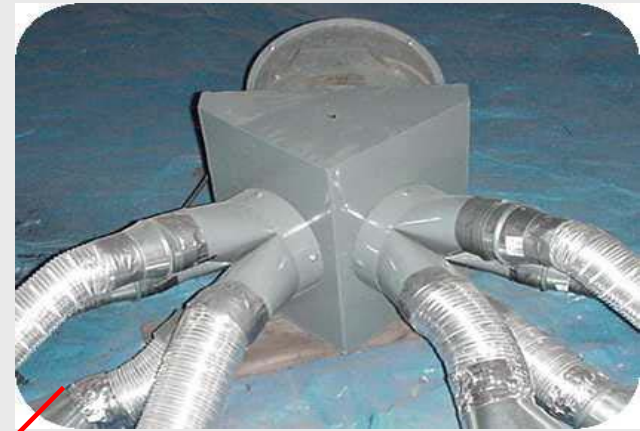
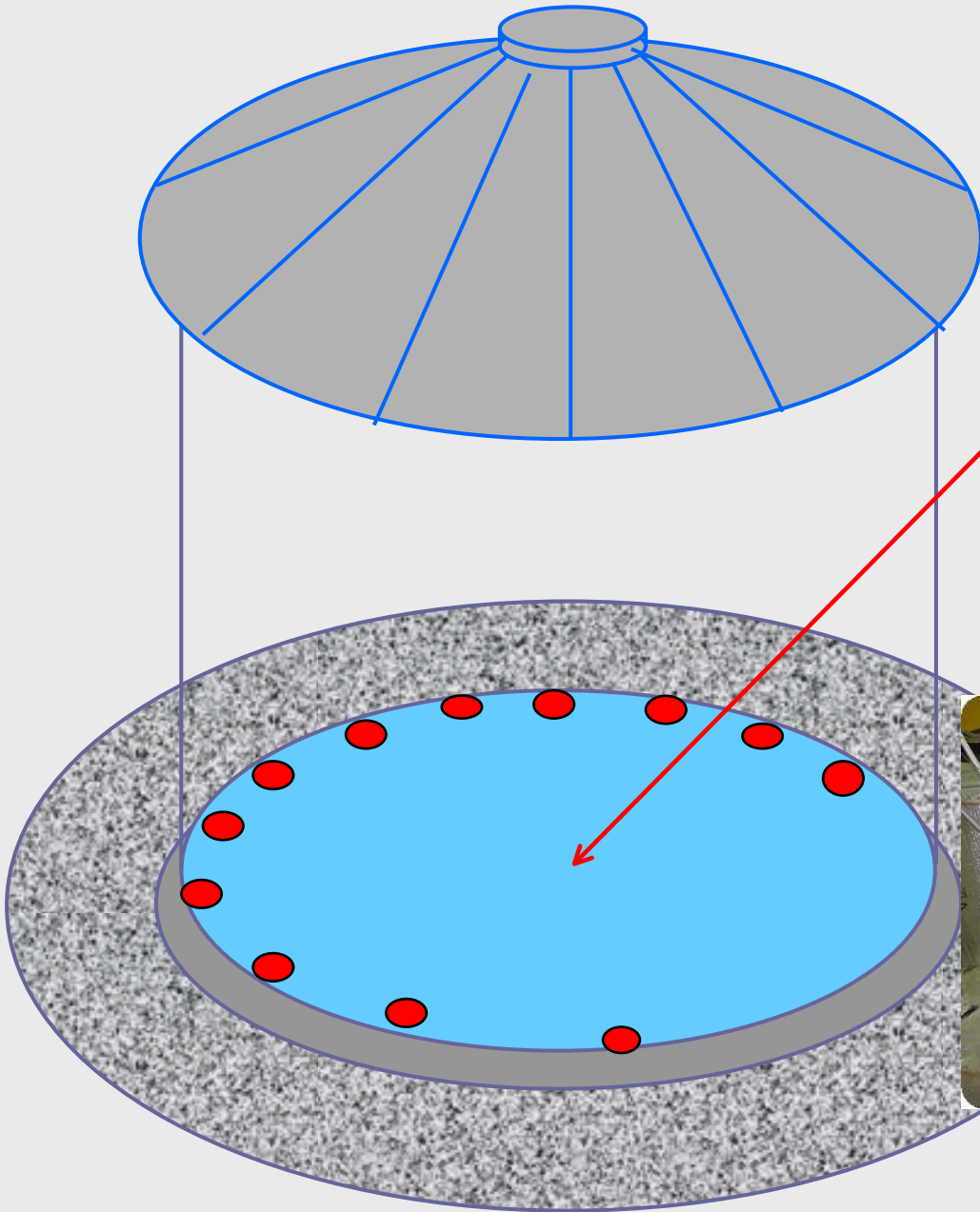
North

East

West

South



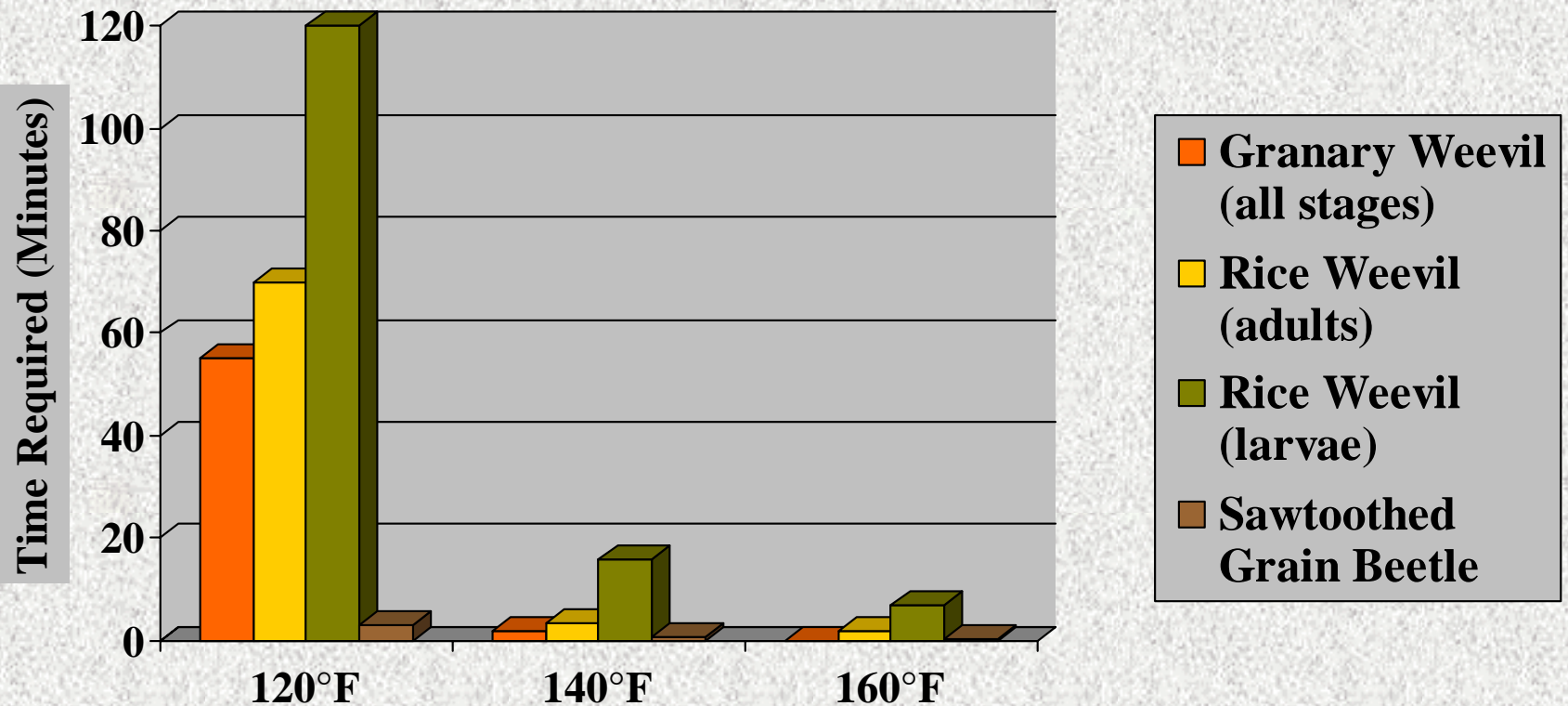


**Manifold and Aeration Fan**



**Inlet of 18 kW Heater**

# Temperature and Time Required to Kill

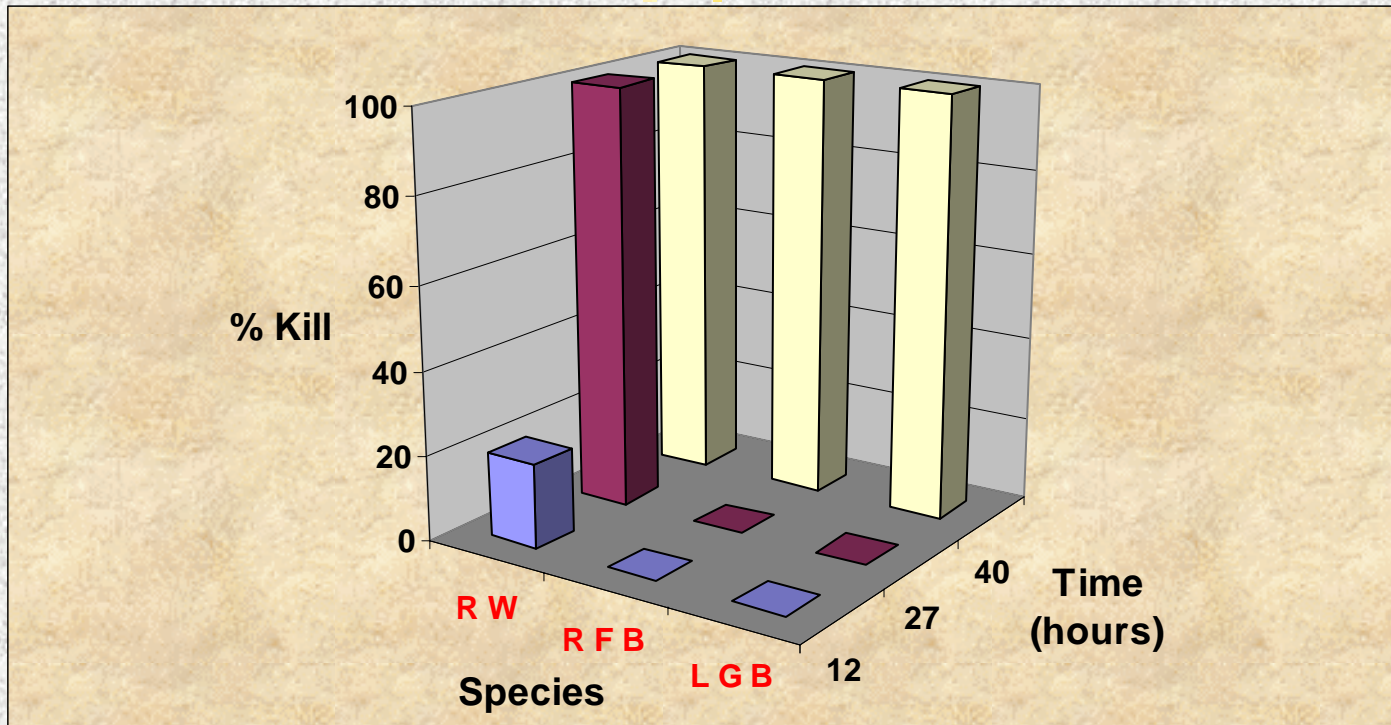


\* Evans, D. E. 1981. The influence of some biological and physical factors on the heat tolerance relationships for *R. dominica* and *S. oryzae*. *J. Stored Prod. Res.* 17:656-72.

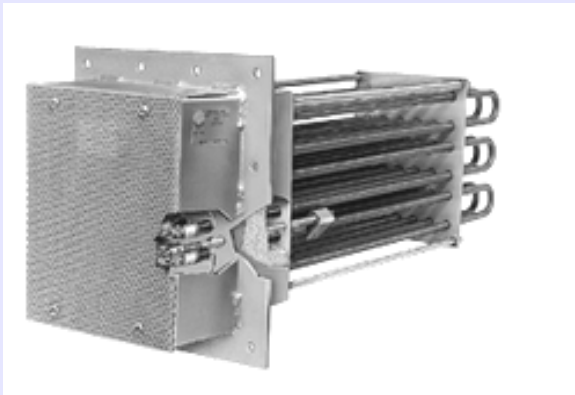


# 18 kW Heating Element

Summary of Kill Results:



# Heating Equipment



Duct Heater

**18 kW or 61,400 BTU**



Forced Air Propane Heaters

65,000 - 85,000 - 100,000 BTU



# Propane Heat Treatment



- 4,000 bu bin
- Perforated floor is covered with a tarp.
- Interior circulation system removed
- Fuel consumption:

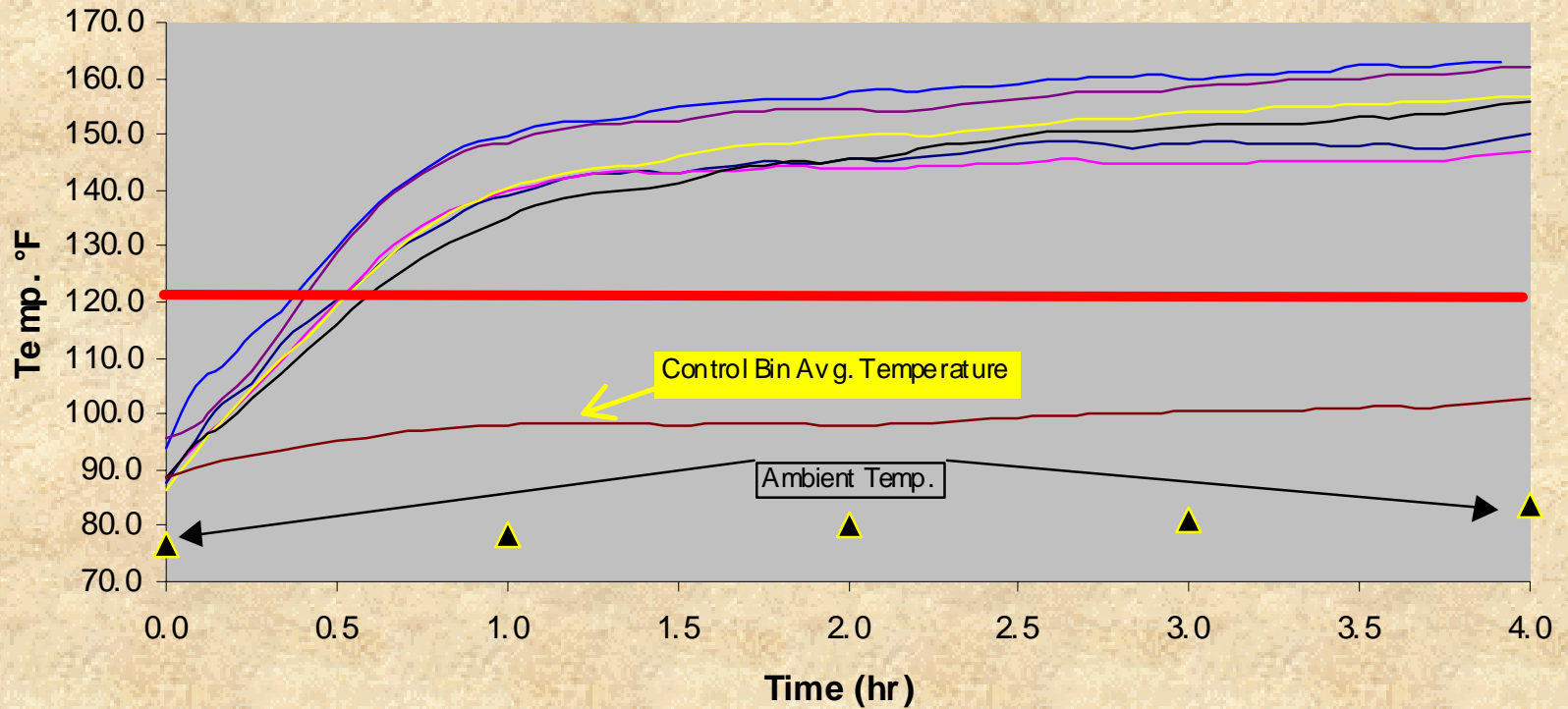
	<u>65K</u>	<u>100K</u>
gallons/hr	0.7	1.1
pounds/hr	3.0	4.6





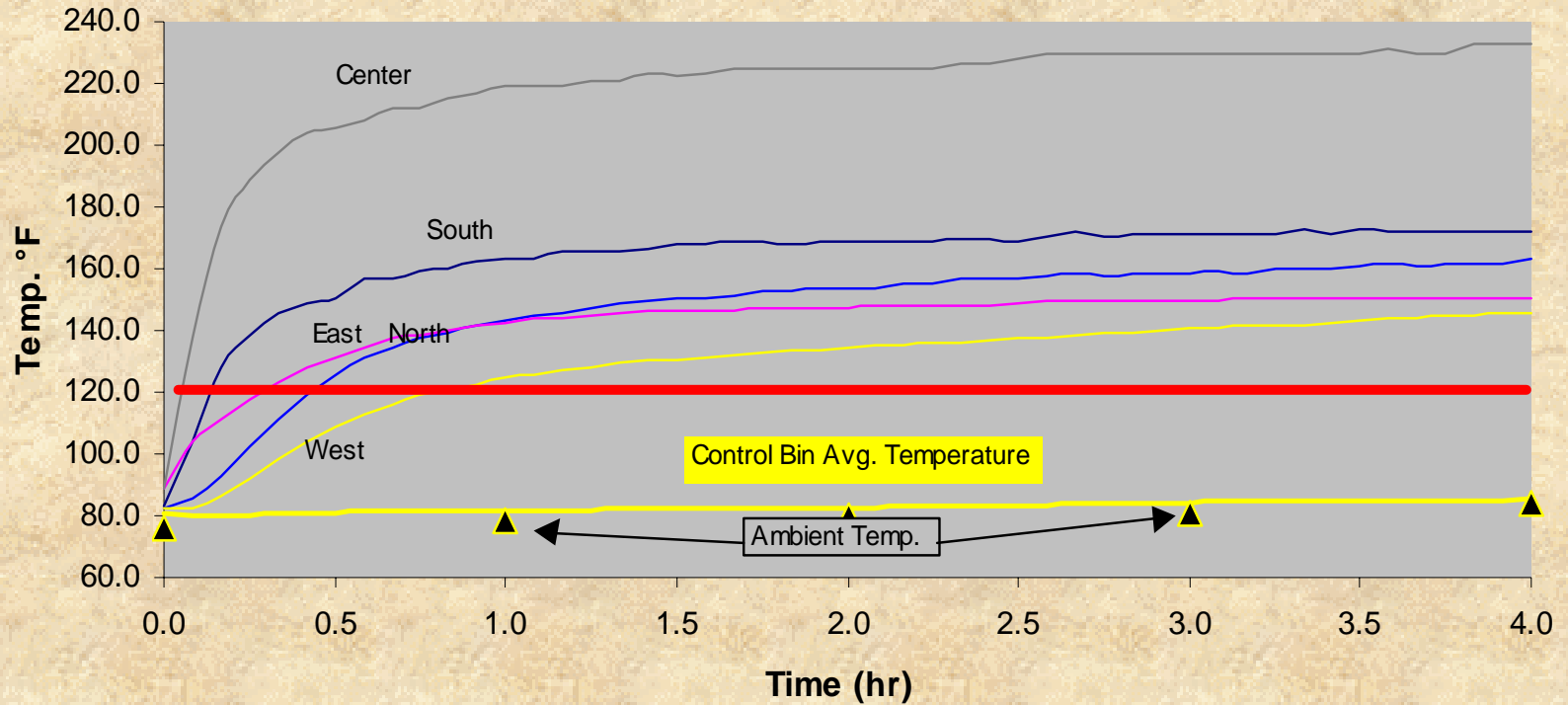


## Propane 100,000 BTU/hr 4 Hour Test Above Drying Floor Average Bin Temperatures



100 % Kill

# Propane 100,000 BTU/hr 4 Hour Test Below Drying Floor Average Bin Temperatures



100 % Kill



# Conclusion



- \* Disinfesting a steel grain bin using heat is a viable option.
- \* Distributing heat uniformly to all parts of the concrete floor is a key for successful treatment.

# Future Plans



- \* Repeat treatments with propane heater at 65,000 BTU
- \* Spot electric heater using recirculated air.
- \* Controlled time motion study of sanitizing a bin by removing flooring and manually cleaning.
- \* Development of economic model to optimize the most efficient and practical application.



# Questions

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