Aeration for Insect Management in Stored Rough Rice

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Aeration

- Low volume-ambient air to modify and alter the bulk grain mass-it is not “drying”
- Aeration is controlled with timer, fans run if temperatures drop below specified thresholds
- Development of most stored-product pests is limited < 60° F

Benefits of Aeration

- Reduces temperatures far more quickly than natural cooling
- Reduction in bin temperatures and in insect population development
- Results demonstrated in modeling simulation studies and confirmed in field tests

Bins at USDA-ARS in Manhattan

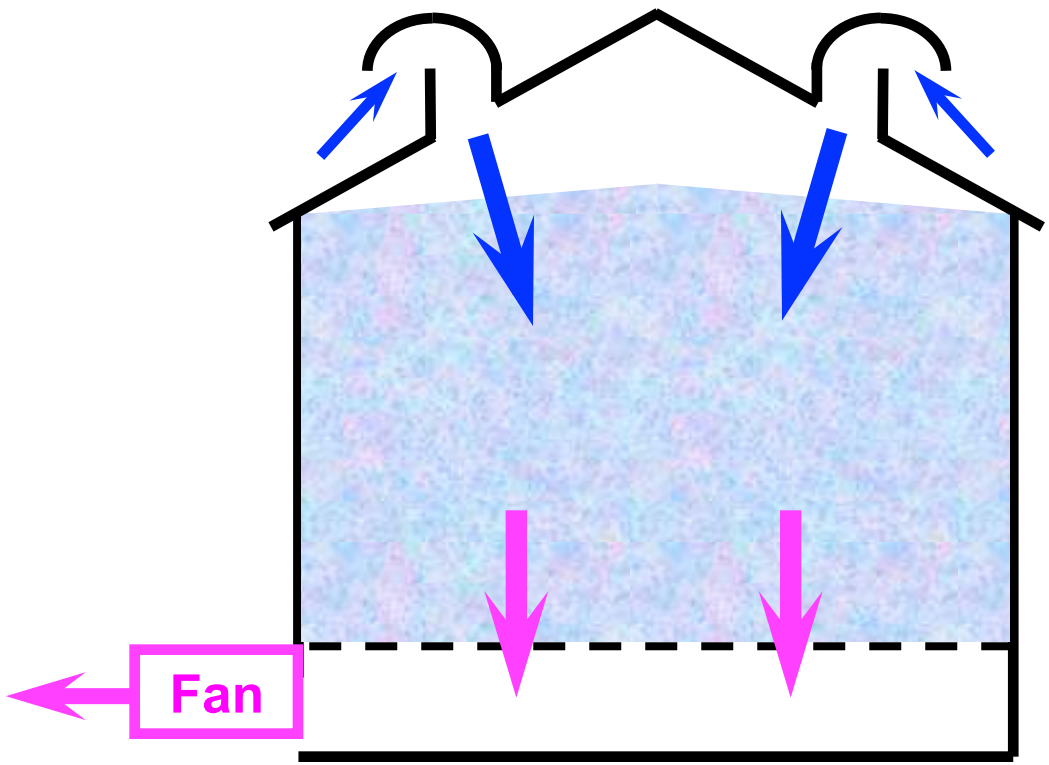
Lesser grain borer (LGB)

Rice Weevil

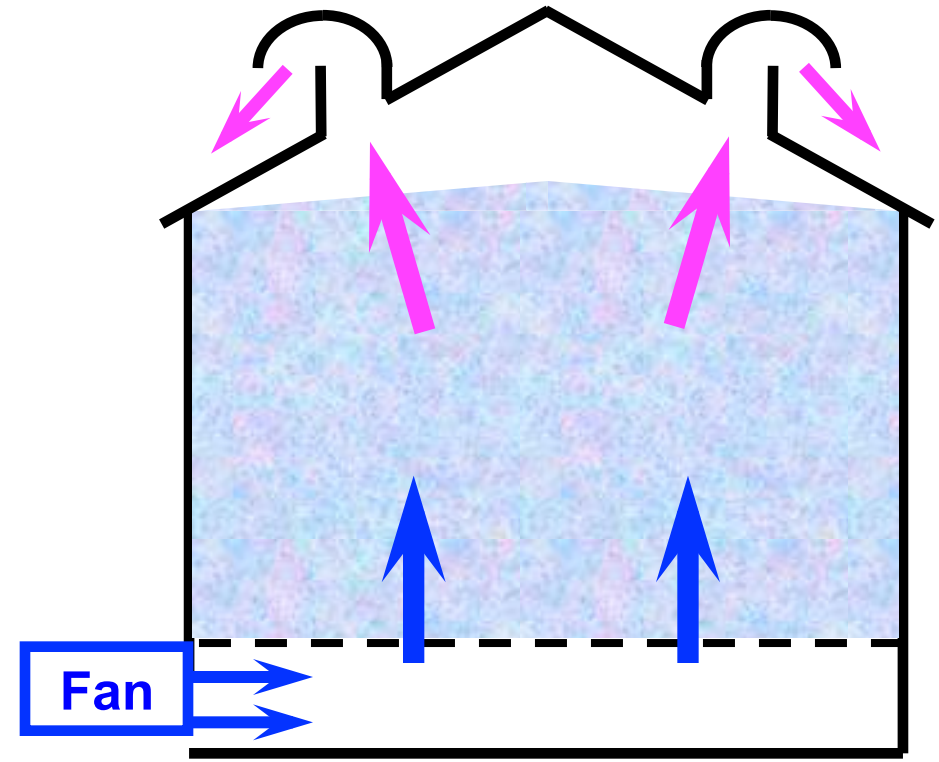
Aeration Research with Wheat

- Simulated field studies in our bins showing aeration quickly lowers grain temperature
- Population studies with natural infestations and with caged insect studies
- Modeling studies with insect population development
- Partially led to aeration studies with rice

Pressure vs. Suction Aeration



Suction (down-flow)



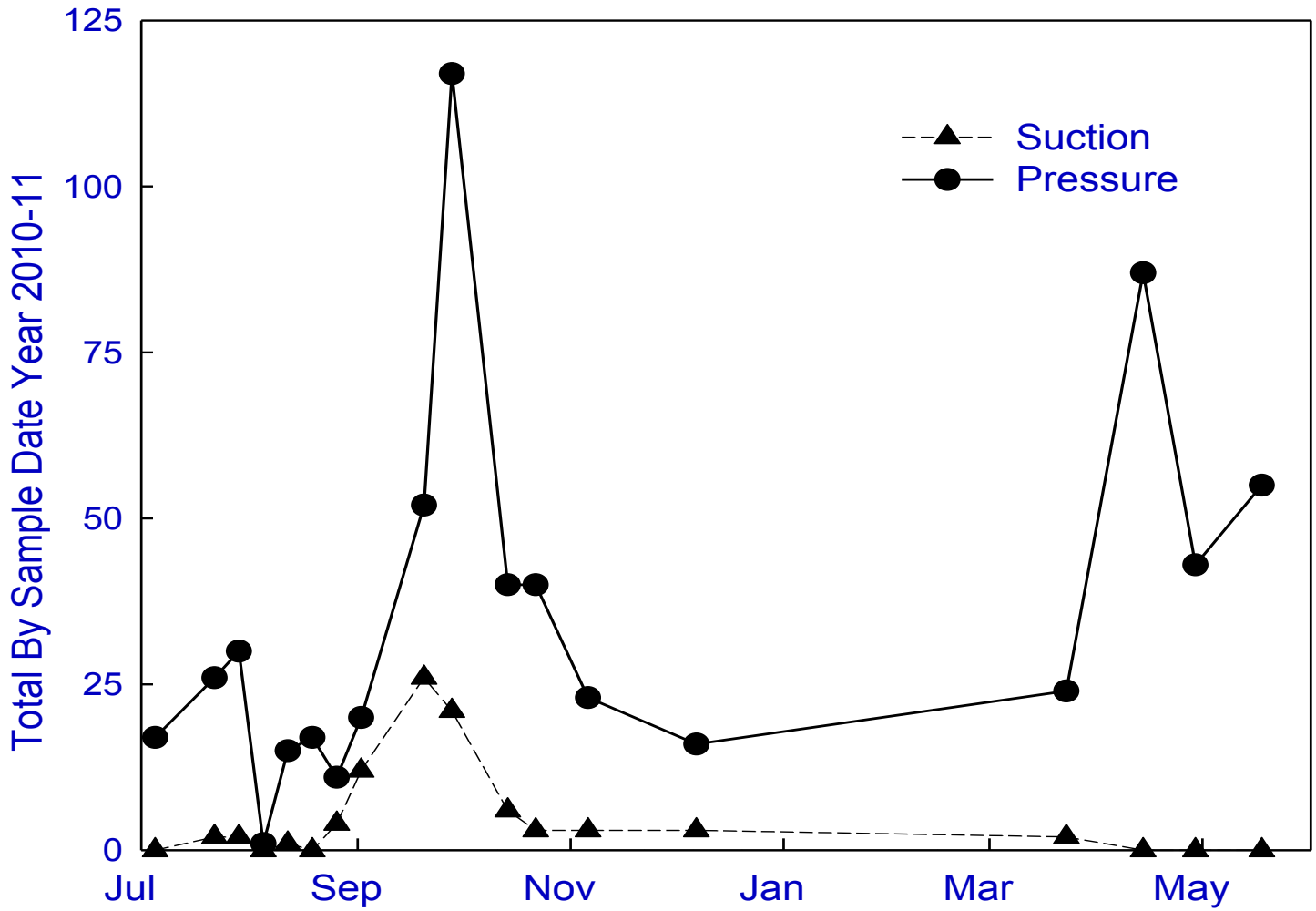
Pressure (up-flow)

Bins for Study- Suction

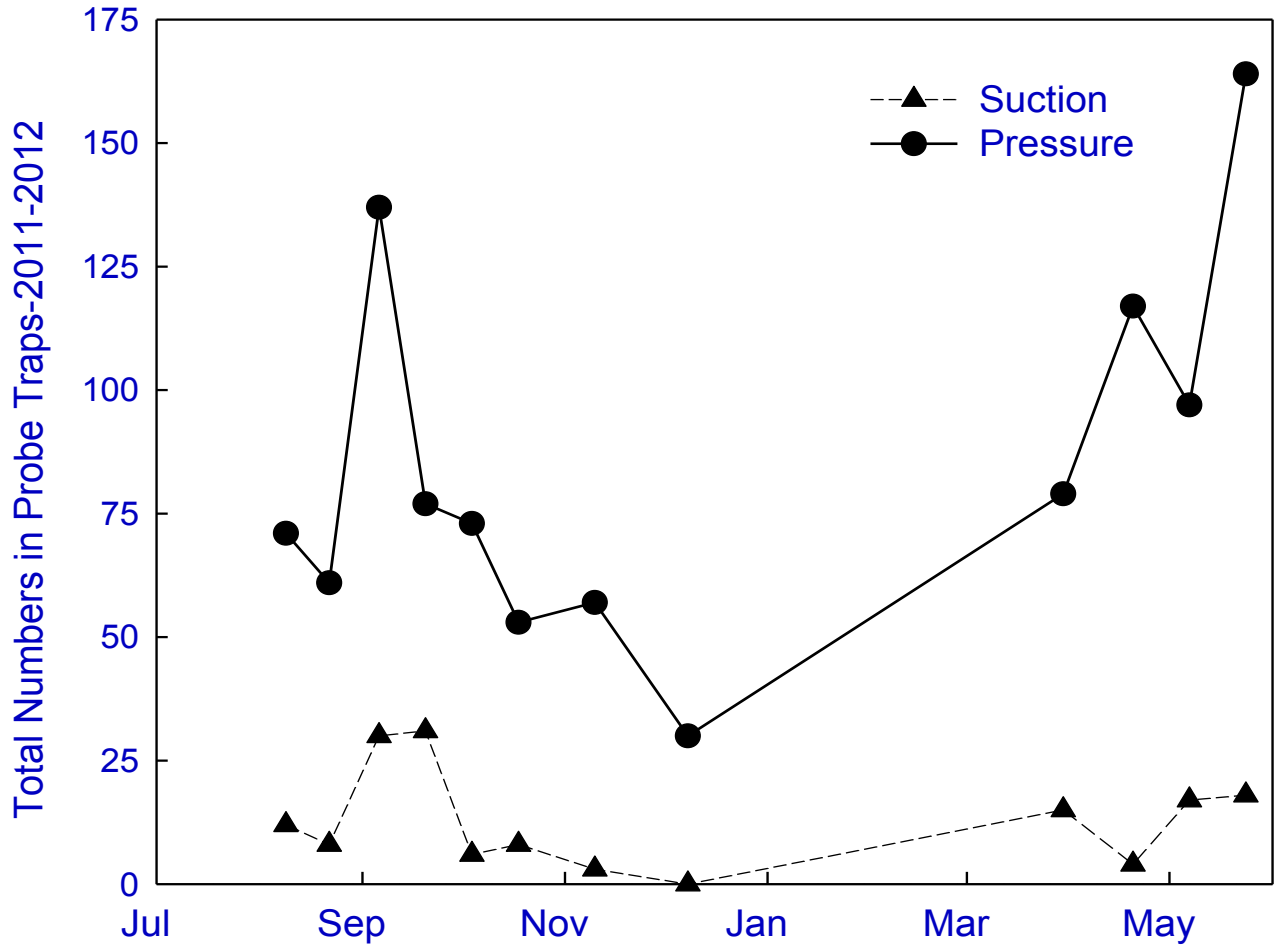
Probe Trap Sampling

Example- Rusty Grain Beetle

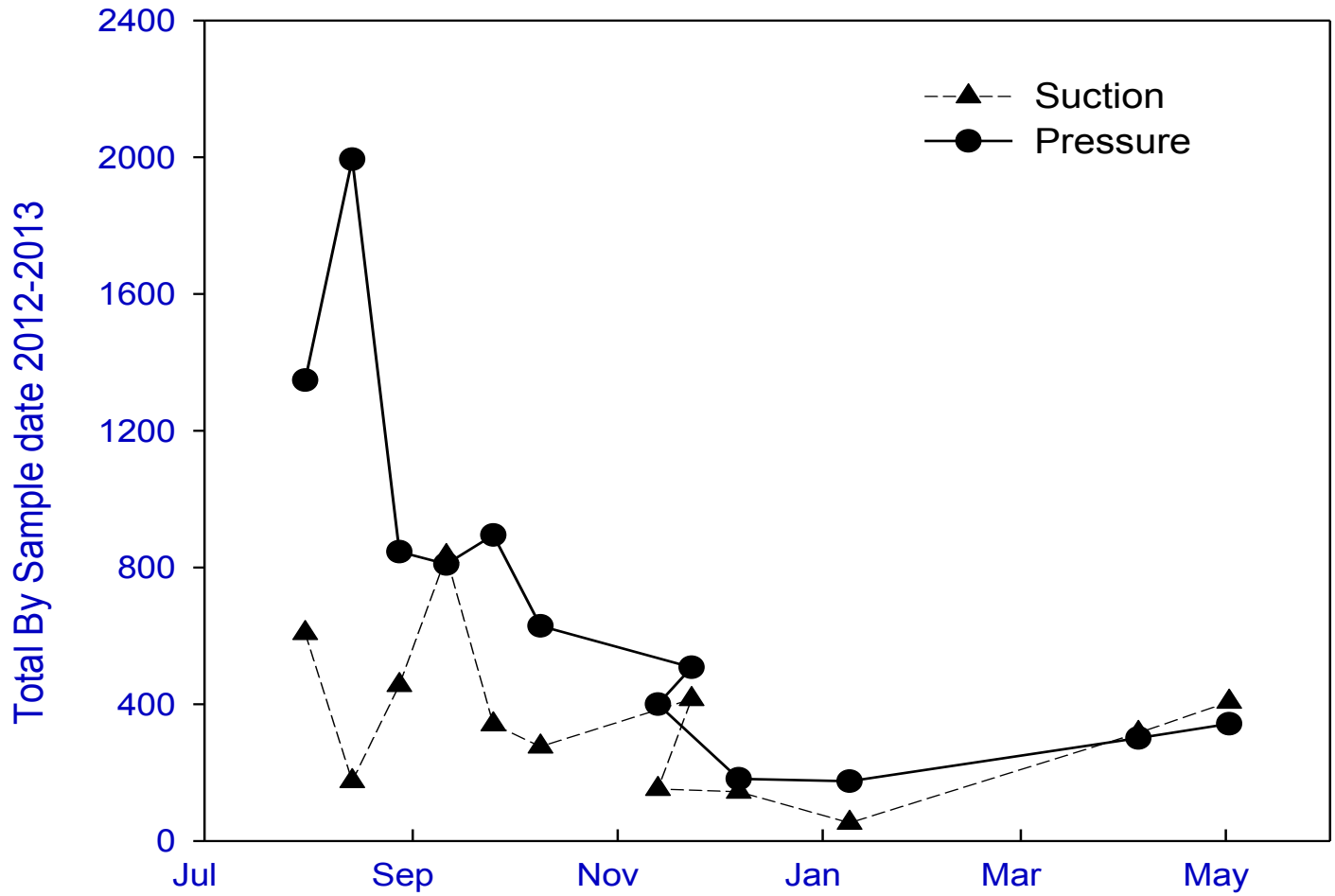
Rusty Grain Beetle: Year 1



Rusty Grain Beetle: Year 2



Rusty Grain Beetle: Year 3



What Happened

- Year 1 and 2, 3-5 times as many rusty grain beetles in pressure bins than in suction bins!
- Year 3, 20 times more rusty grain beetles in both types of bins
- Wheat fumigated at end of each storage time
- Was our elevator silo infested? Results show importance of cleaning and sanitation

Pilot Grain Elevator

Residual Infestation in Silos

- Previous studies show that residual grain in silos lead to quick infestations common
- Sanitation in cleaning is difficult in silo bottoms, especially as bin size increases
- Aeration may have little overall effect when these residual infestations are present

Aeration Research with Rice

- Little research in the past 20 years on aeration for insect pest management
- New research initiated with the U. of Arkansas in early 2000s, expanded to include modeling group at TAMU-Beaumont
- Will discuss some relevant studies with rice

Example: Manual Versus Controlled Aeration

- Field studies in MO, AR, and TX
- Bins artificially infested with lesser grain borers (LGB) inside "cages" with rough rice
- Cages sampled at 5, 10, and 15 weeks after insertion into bins

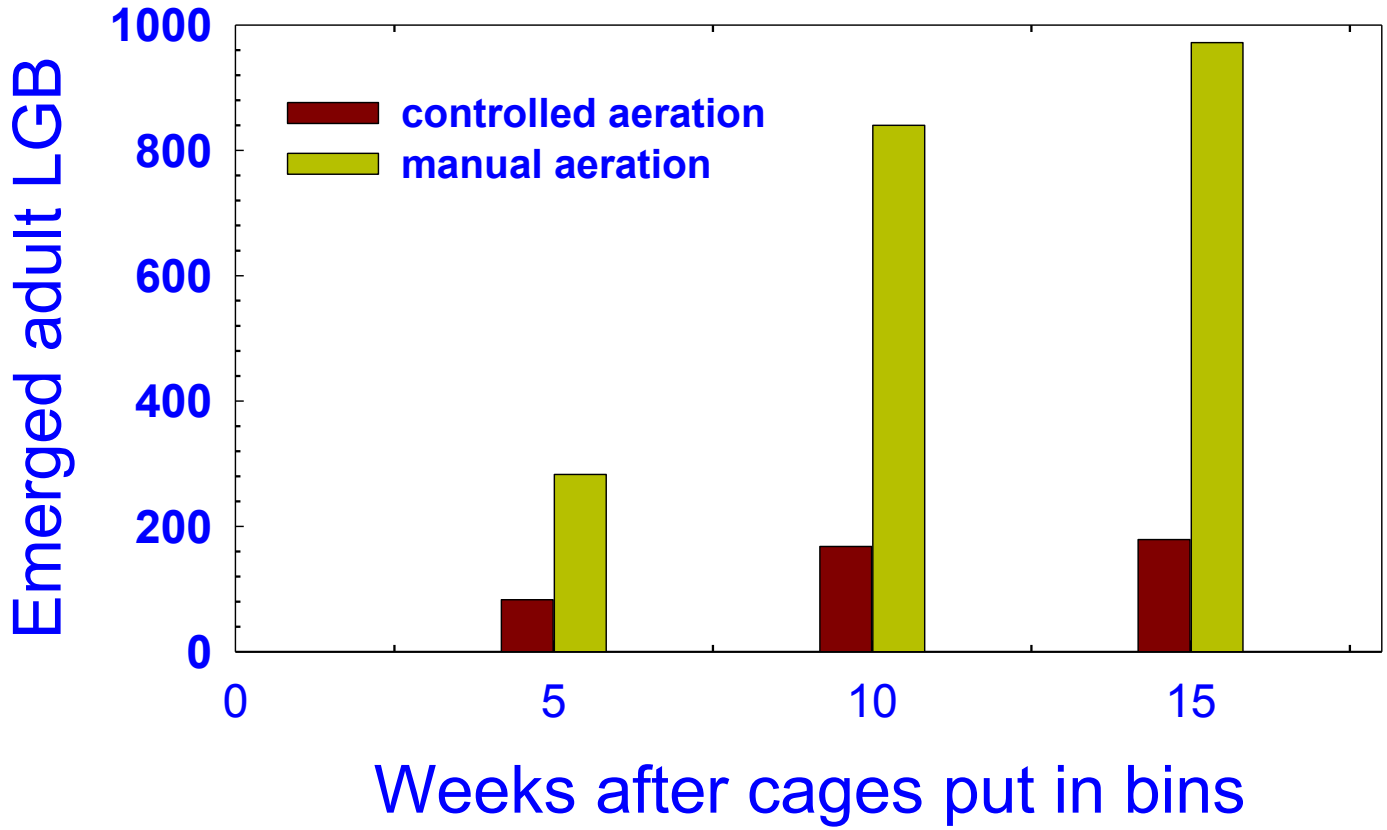
Results

- No growth and reproduction in LGB populations in any of the bins in MO and AR
- Tests started in October in AR, November in MO, temperatures a limiting factor
- In TX, warmer climate and earlier storage, data show benefits of controlled aeration

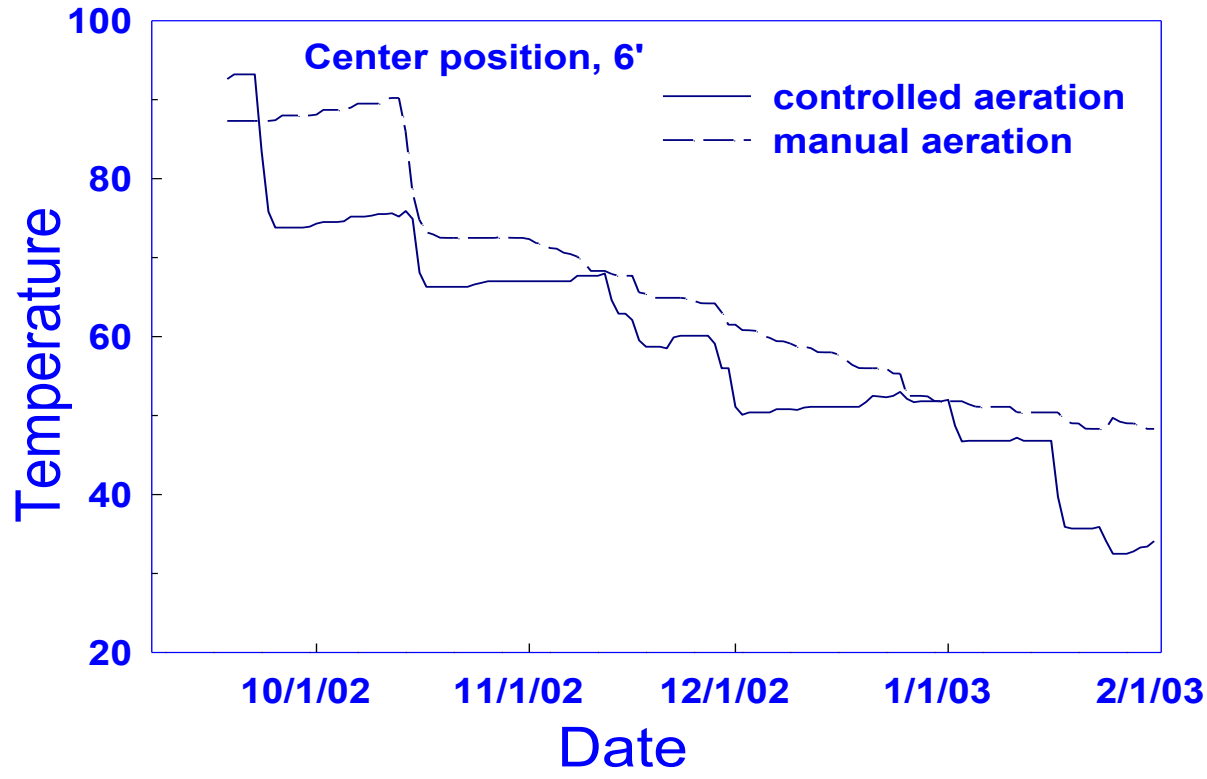
Texas Data

- 2 bins with manual aeration, cooperators turned on fans
- 2 bins with controlled aeration, at set points of 70, 60, and 45°F, about 0.5 CFM/bu
- Project initiated in 9/17, 80 adults in 4 cages
- Results just for lesser grain borer

TX Bin Site


Emerged adult LGB
1000
800
600
400
200
0
controlled aeration
manual aeration
0
5
10
15
Weeks after cages put in bins

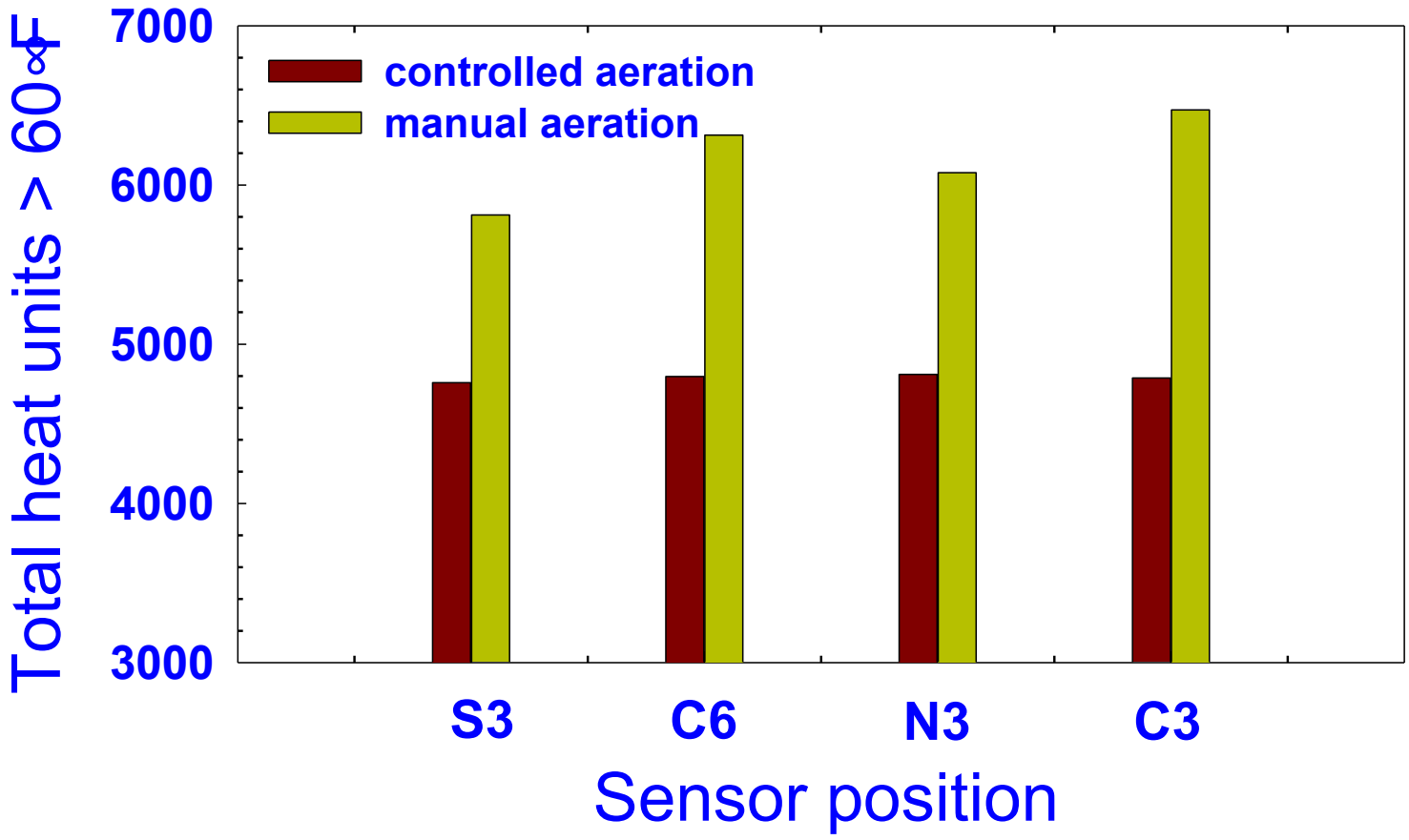
Bin Temperatures in TX



Estimating Generations

- At 70, 80, and 90°F, about 7, 6, and 5 weeks are needed for LGB to reach adult stage
- 5 weeks x 7 days x 90°F = 3150, number increases as temperature decreases
- Examine heat units from controlled aeration versus manual aeration, using value of 3100

Heat Units in TX



Number of LGB generations

- Data indicate 1 complete generation was produced in bins with controlled aeration
- Two generations may have been produced in bins with manual aeration
- More important, fecundity and reproduction of LGB is greater at higher temperatures

Problems with Aeration Field Trials

- Target insects may not show up
- Cooperators will not let you put live insects in their grain bins
- Safety considerations now limit field research-barriers and legal liability for bin entry
- We can compensate somewhat by using modeling strategies

Historical Weather Data

- We can use weather data to predict number of hours available for bin cooling
- Will be applicable to any size bin, it is the airflow rate and temperature that are critical
- Look at specific examples from studies

Example: Corn in Southern USA

- Fall Crop, harvested and binned from mid-August to early October
- Development of most stored-product insects is limited < 60°F
- Without aeration, bin temperatures will be above 60°F for several months

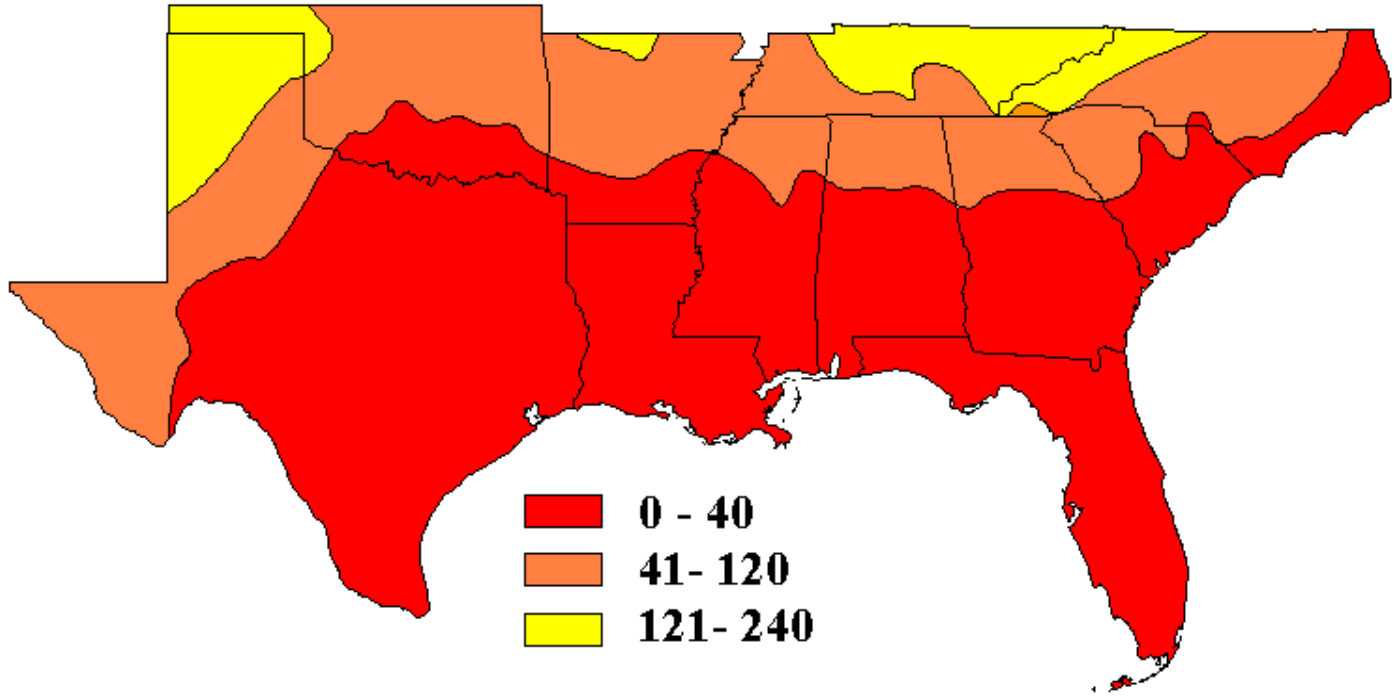
Assumptions: Weather Data

- 11 states were defined as comprising the southern USA
- Data for each year from 30 years were averaged for > 400 weather sites
- Hours below 60°F in Sept. & Oct. were totaled and mapped

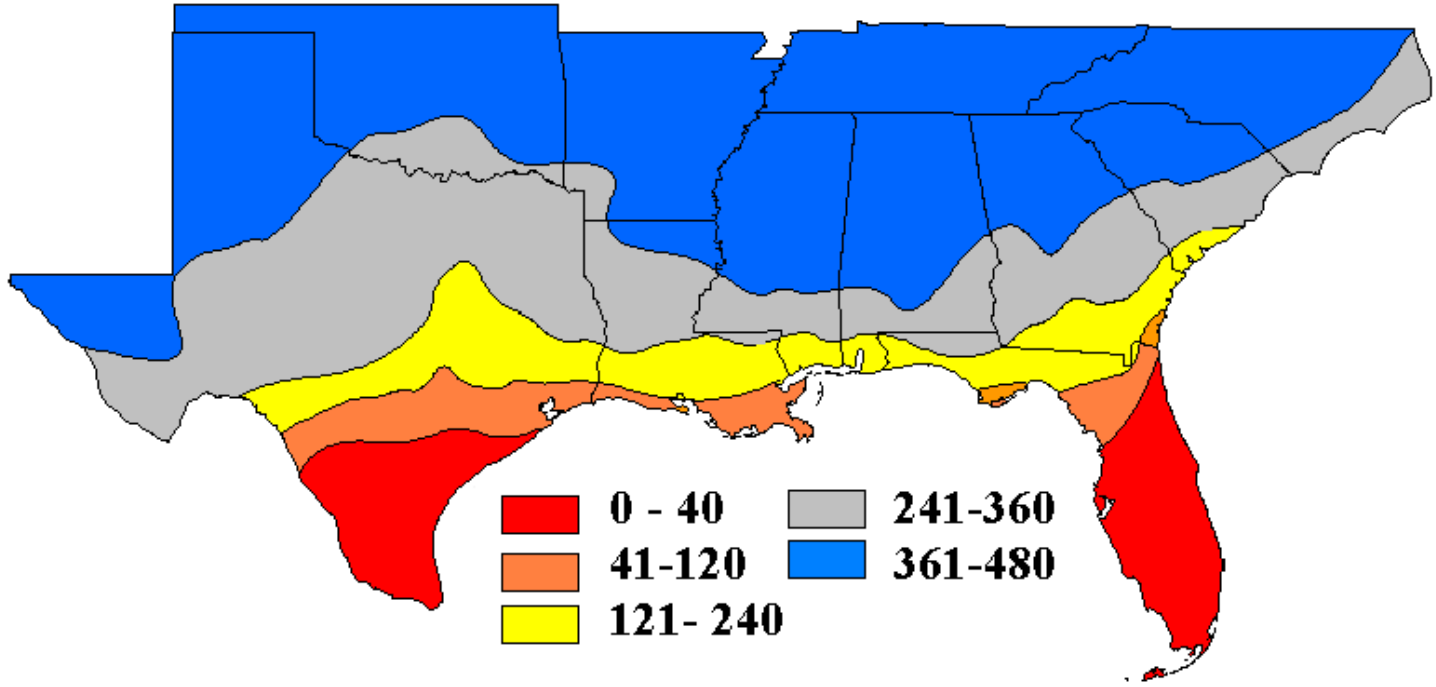
Results: Weather Data

- No hours < 55°F are accumulated in September
- Many areas do not have a total of 120 hours < 55°F at the end of October
- 120 hours below 60°F are accumulated by 10/31 throughout most of the region

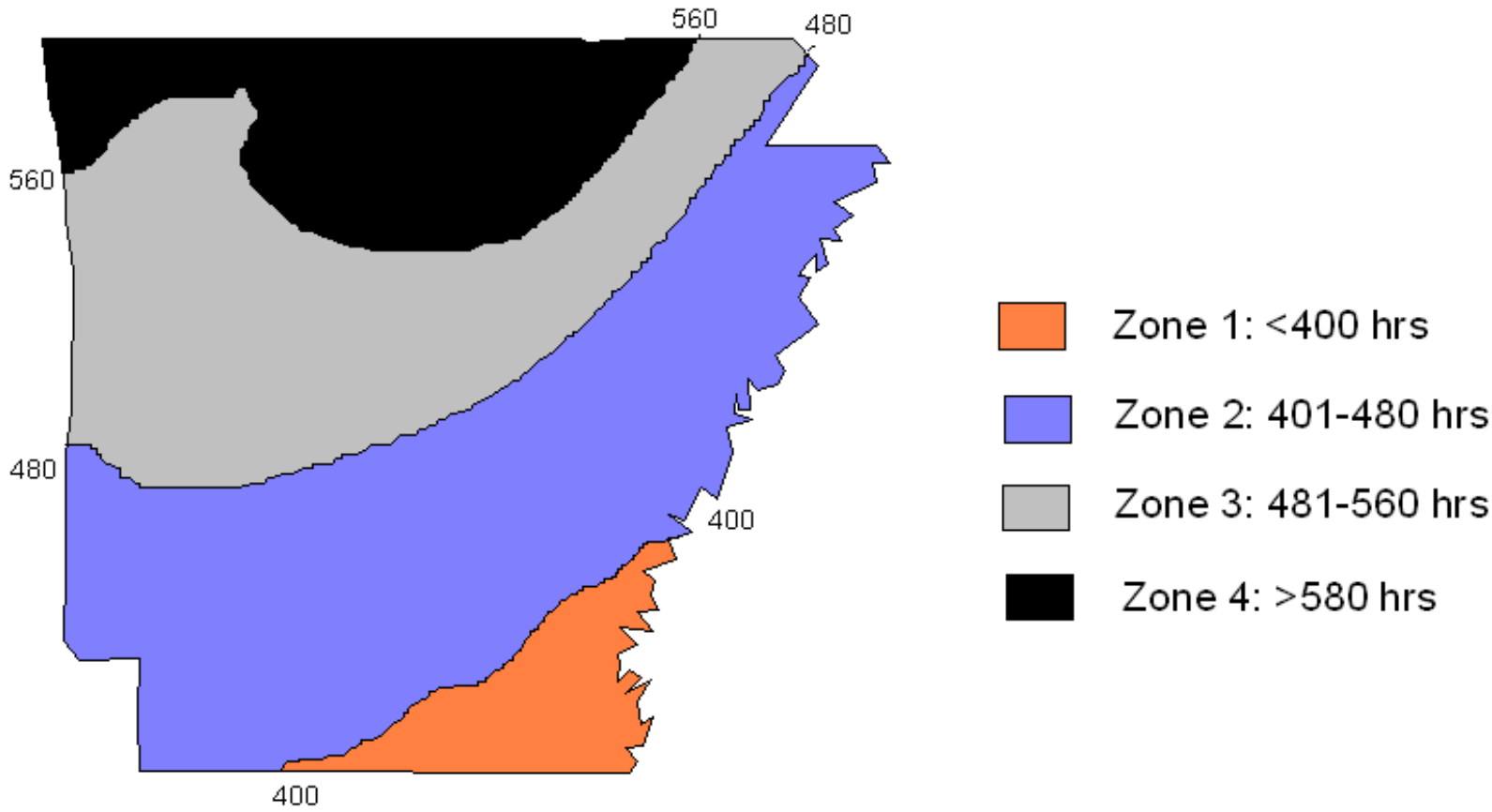
Hours < 60°F in Sept.



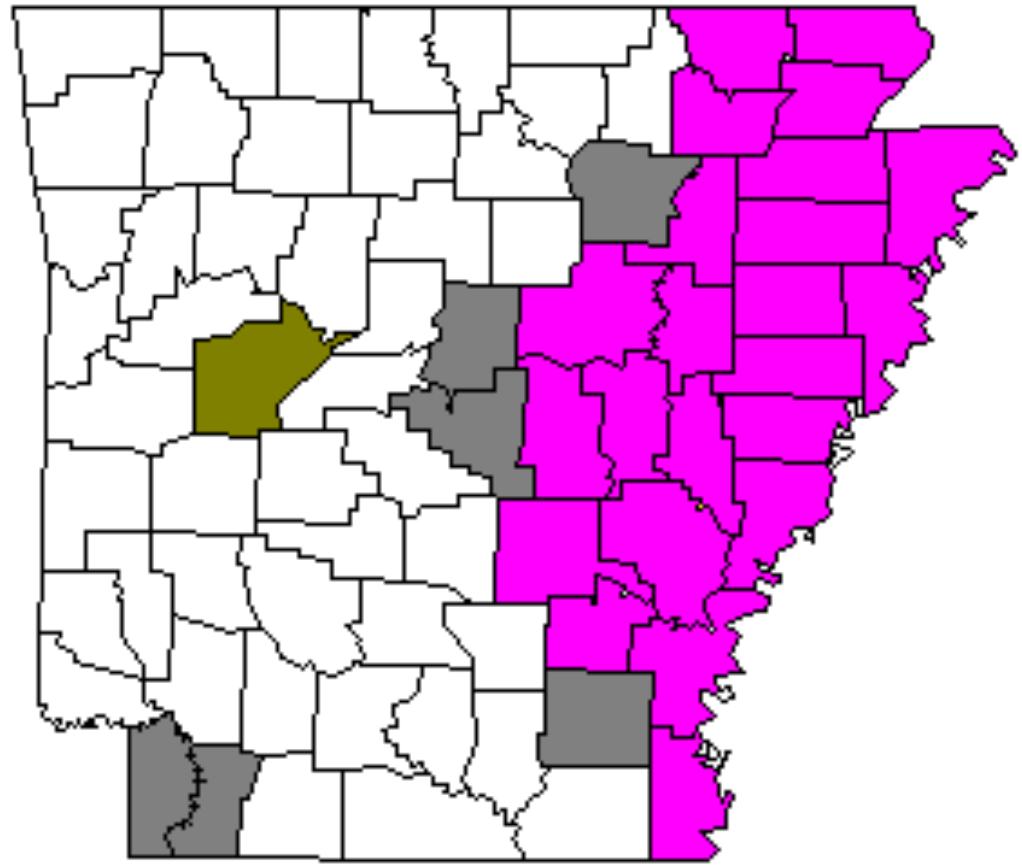
Hours < 60°F in Oct.



Hours < 60°F in AR from 9/1 to 10/31, 4 general zones defined



Rice Production in AR (AR Ag. Statistics Service)



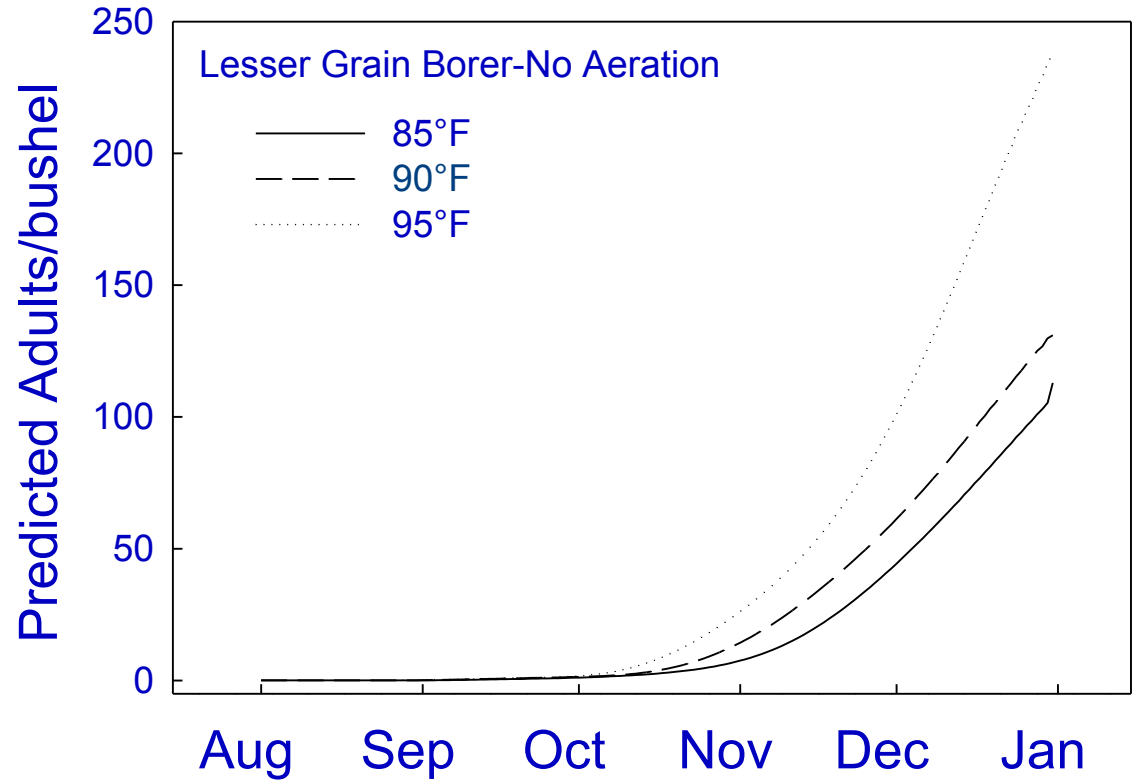
Modeling Data

- Can use population models to predict growth of insects
- A web-based management system, http://beaumont.tamu.edu/grainmanagement
- Integrates weather data with insect modeling data to show effects of aeration

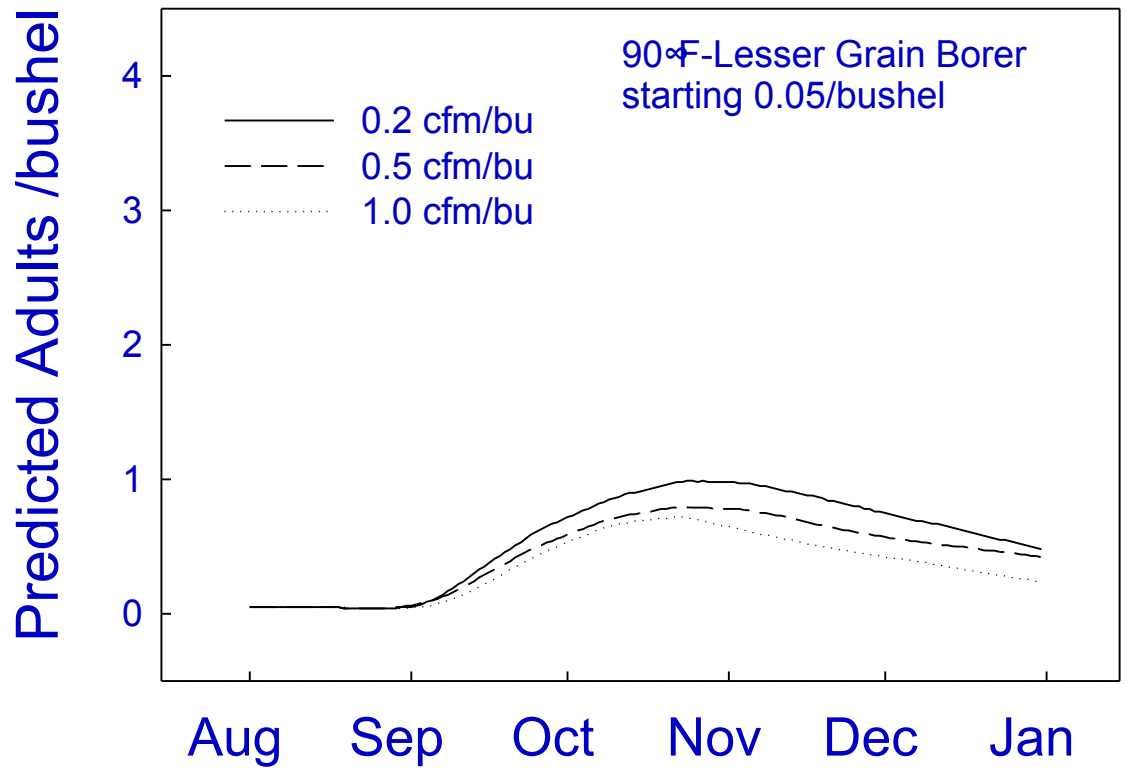
Example-Beaumont TX

- Starting population was 0.05 insects/ bu bushel of rice, three aeration fan cooling speeds, starting grain temperature of 85,90,95°F-continual aeration
- Binning on 1 August infestation next day
- Results for unaerated versus aerated rice

Unaerated Rice



Aerated Rice-Start is 90°F



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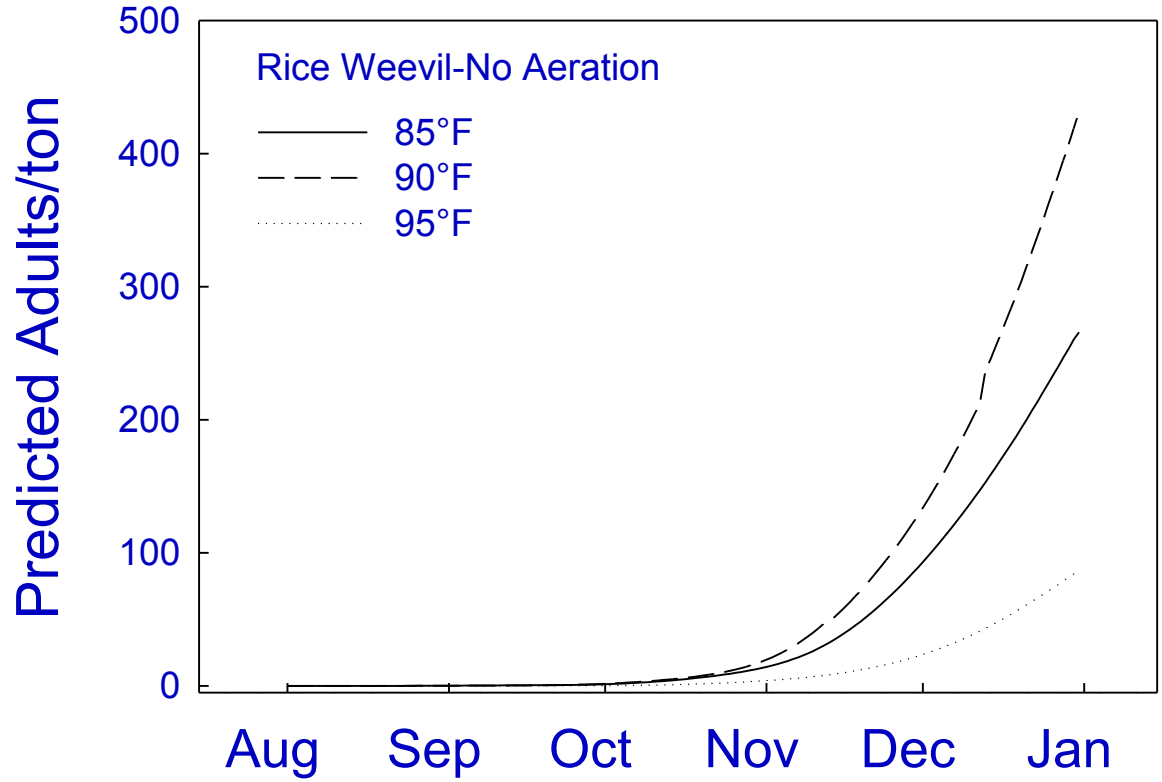

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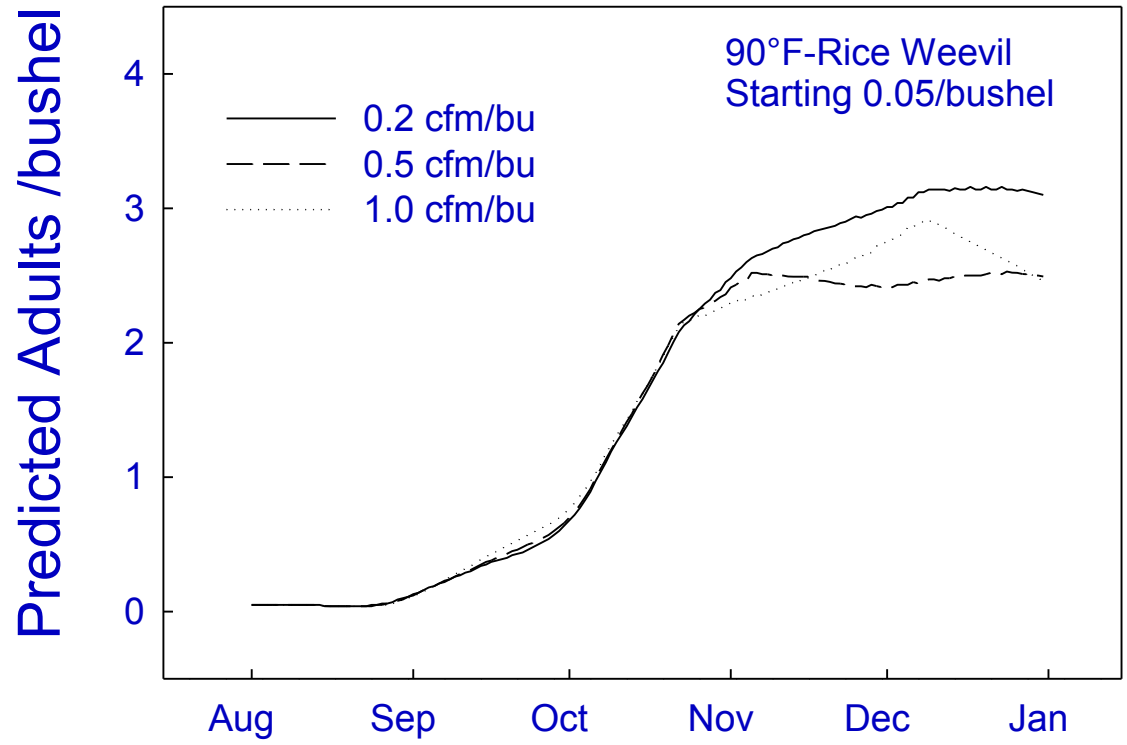

Conclusions

- We know aeration works, can cite numerous examples from research with stored wheat
- Field research in bulk bins is now difficult if not impossible
- Modeling offers a way to examine how aeration can be used for stored rice

For More Information

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- Publications on wheat aeration
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