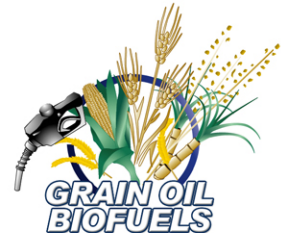




## **Yeast Activity Monitoring**

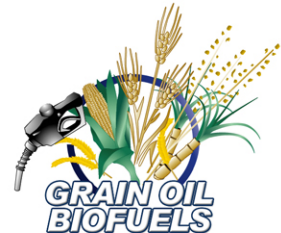
***Fuel Ethanol Lab Manager's Conf.  
November 10<sup>th</sup>, 2009  
Omaha, Nebraska***



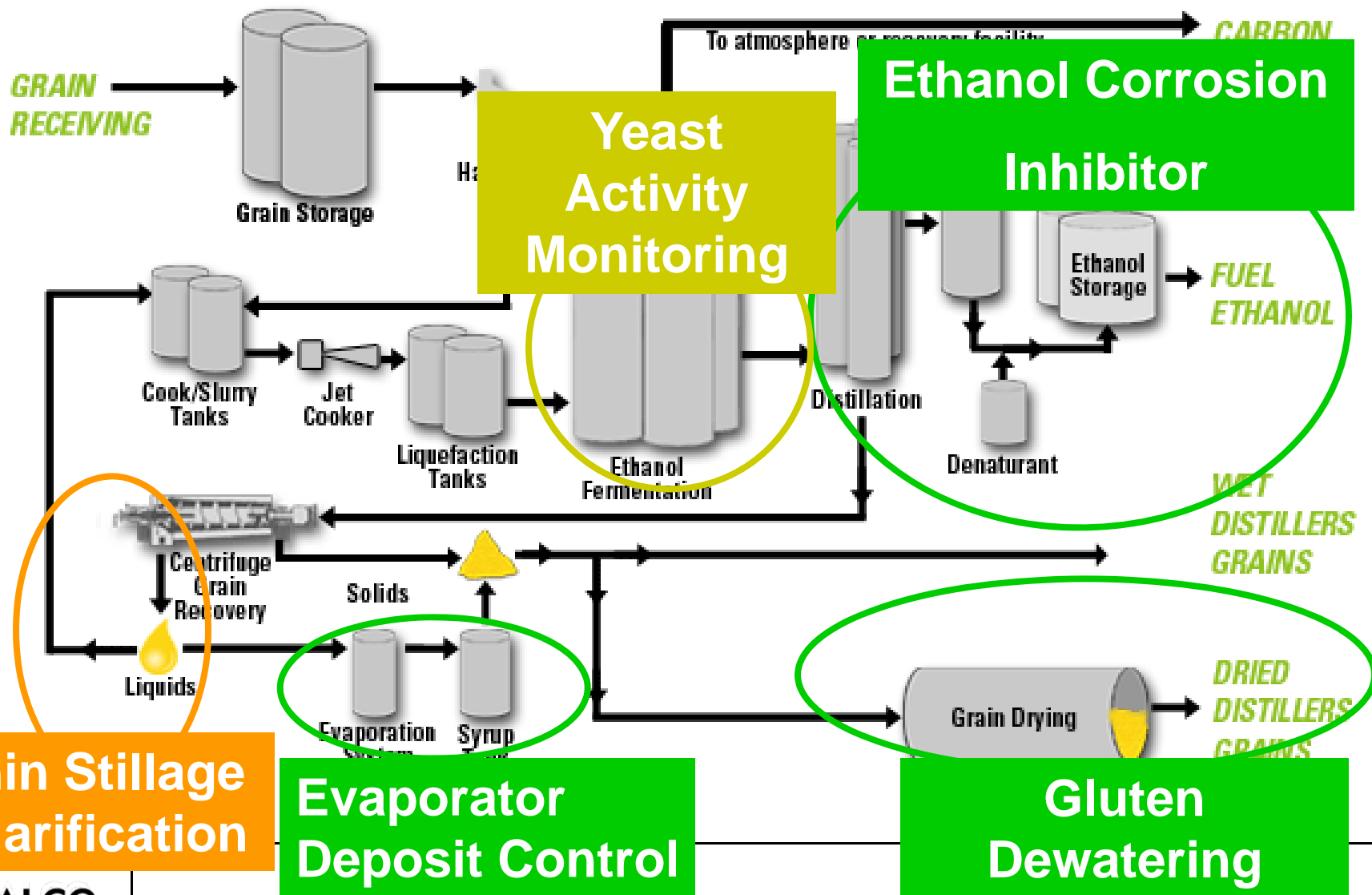
# Presentation Overview

---

- Nalco Process Offerings in Ethanol
- Yeast Management Options
- Metabolic Activity & Fluorescence
- Development and Performance
- Technology Benefits
- Live Demonstration



# Ethanol Process Offerings



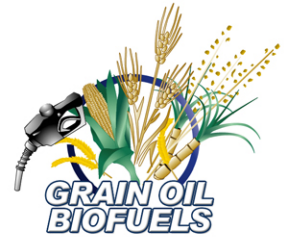
**Thin Stillage Clarification**

**Evaporator Deposit Control**

**Gluten Dewatering**

**Ethanol Corrosion Inhibitor**

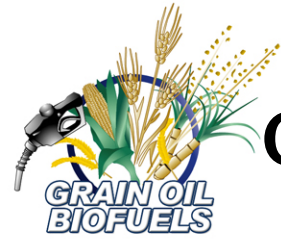
**Yeast Activity Monitoring**



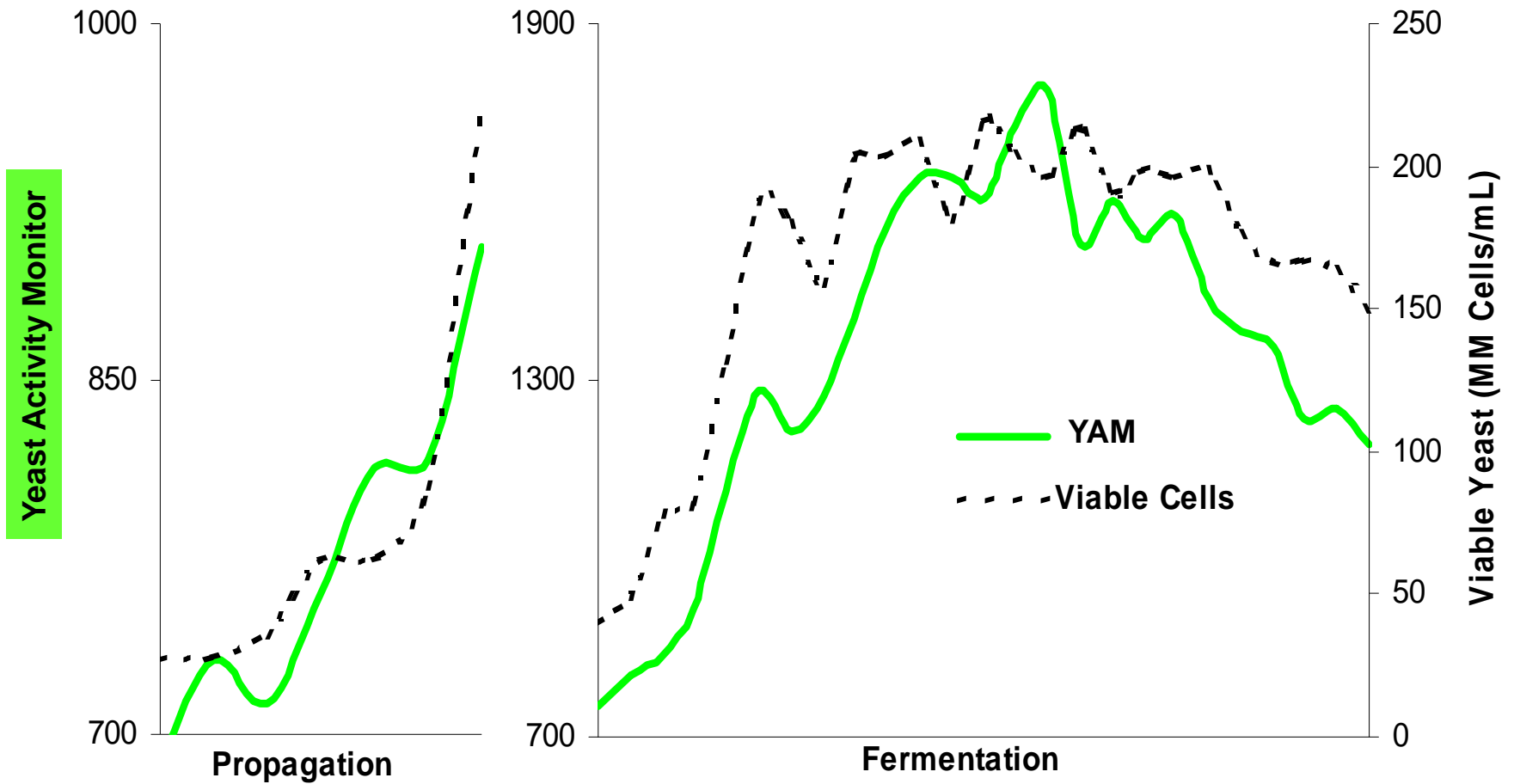
# Yeast Management Options

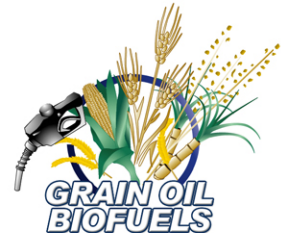
---

- Traditional
  - Microscope, hemacytometer, methylene blue.
  - Tedious, inconsistent, and binary information.
- Automated Cell Counters
  - Microscope in a box.
- Metabolic Activity Testing.
  - Non-subjective method of analysis.
  - Rapid and quantitative testing.
  - Parallel measurement capability

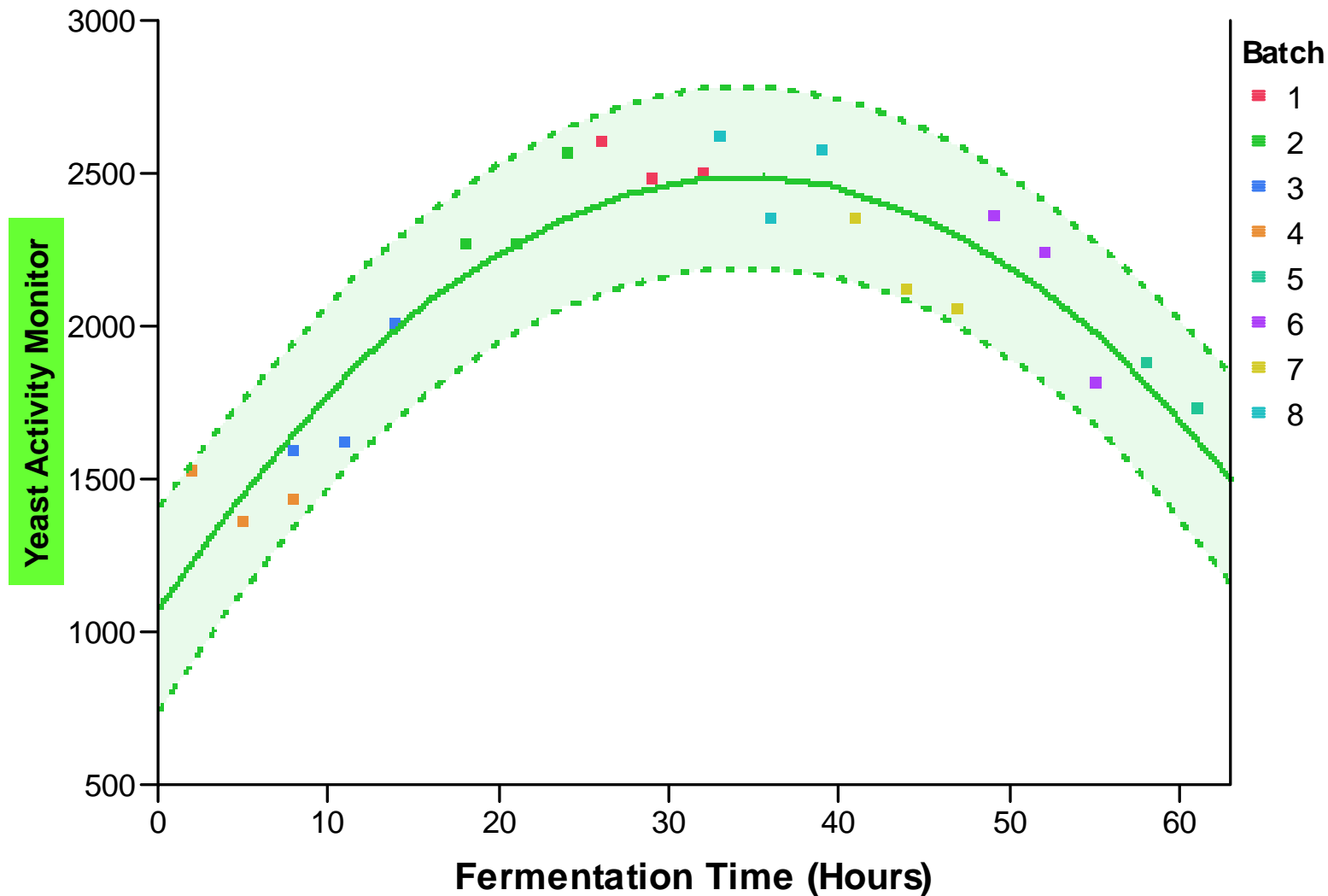


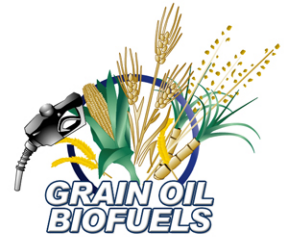
# Correlation with Viable Yeast Counts



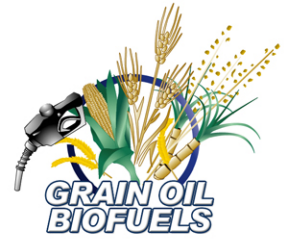


# Profile of Yeast Activity

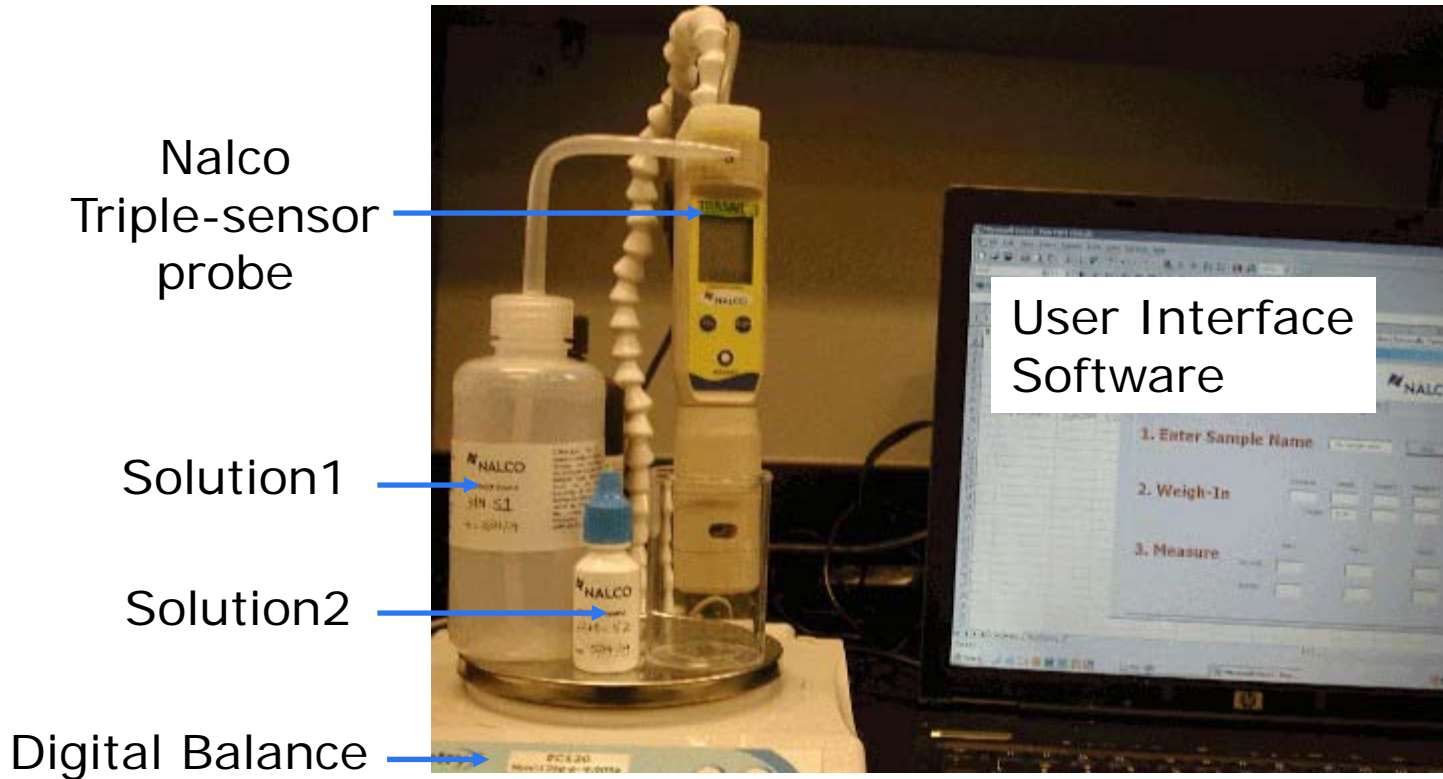


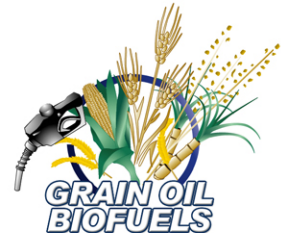


- Implementation
  - Quick, but not easy or automated.
  - Non-subjective, but operator technique important.
  - Parallel testing, but not capable of matching results between different systems/fluorometers.
  - Quantitative, but suffers from lack of data management.
- Fundamentals
  - Small Volumetric Sample Handling.
  - Imprecise Reaction Timing.
  - Uncontrolled Light Scattering Effects (Turbidity).
  - Restricted Reaction Temperature.
  - Weak Yeast Vitality Signal.



# YAM Prototype

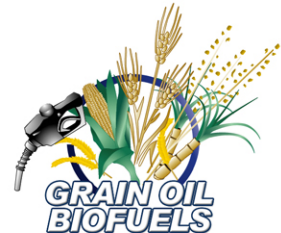




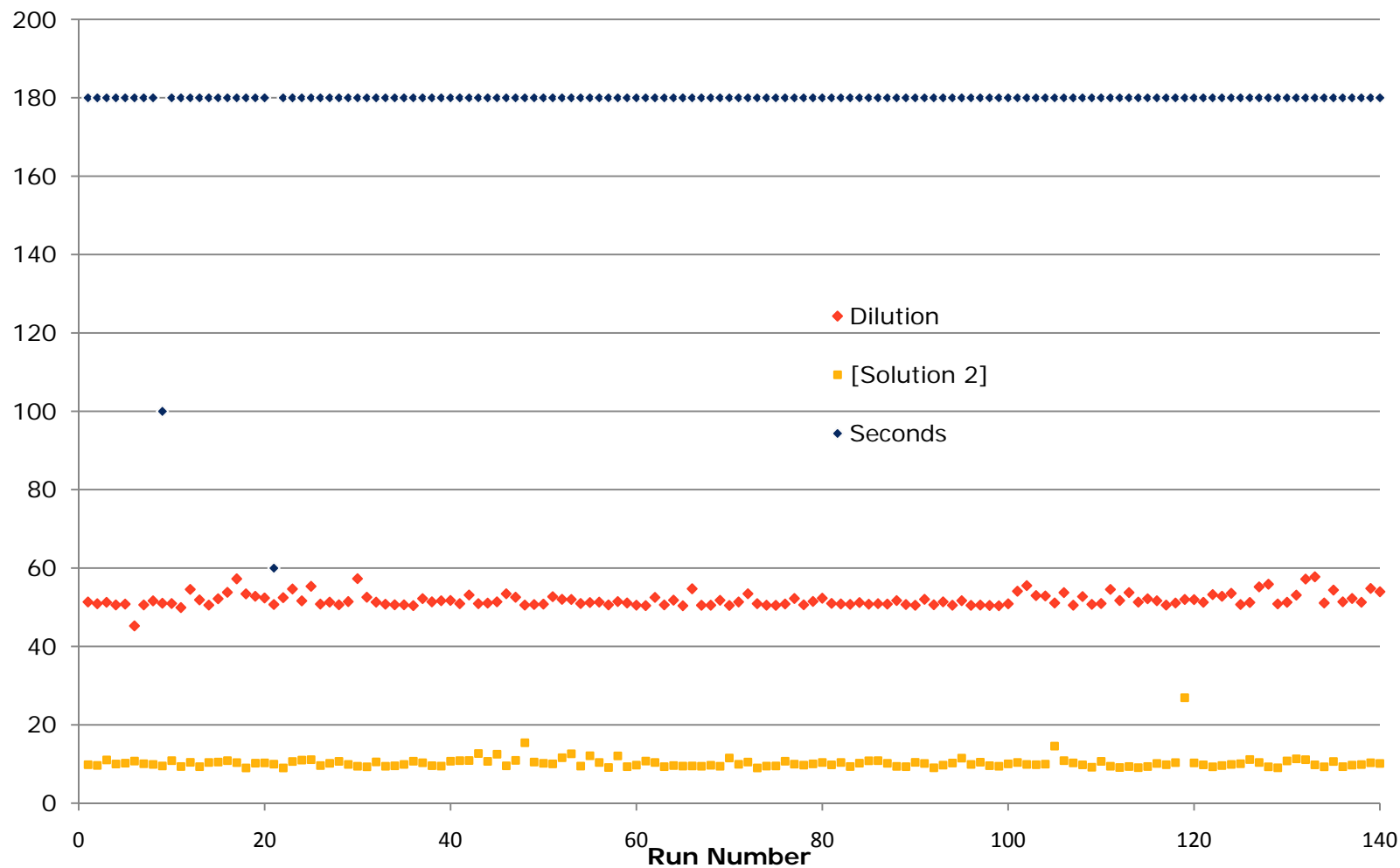
# Performance Evaluation

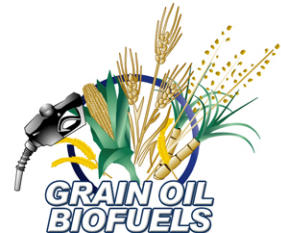
---

- Evaluation Objectives
  - Software operation and reliability.
  - Sample preparation consistency.
  - Usability by multiple operators.
  - Comparison to Version 1.0 performance
- Summary
  - Three different users (1 Supervisor and 2 Lab Techs)
  - Consistently hit sample preparation targets.
  - Achieved good activity profile across process.
  - Higher signal:noise ratio
  - Strong yeast vitality signal.

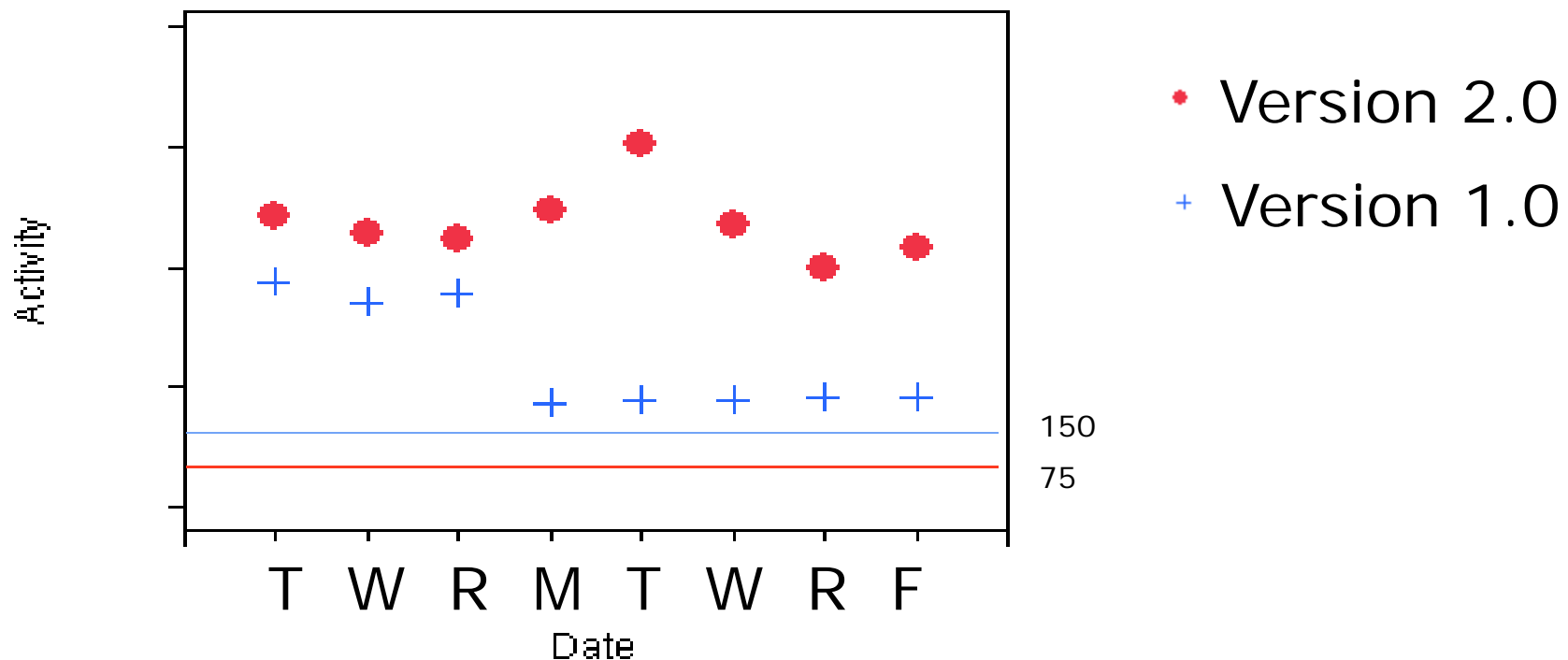


# Sample Preparation Consistency

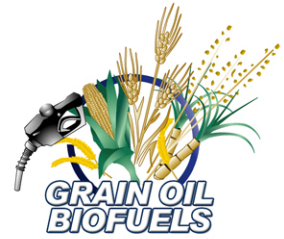




# Head-to-Head Comparison

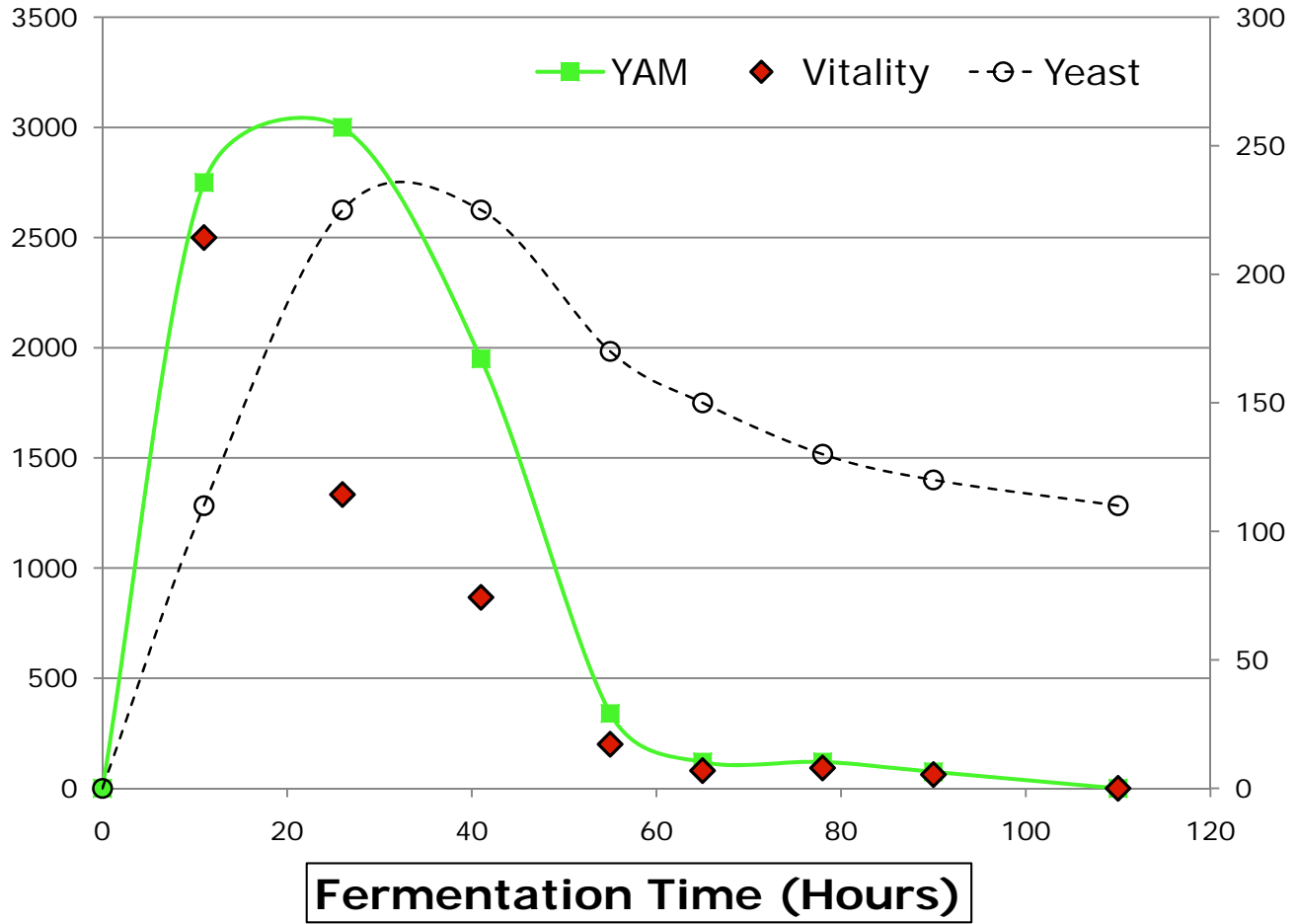


Higher S:N Ratio  
Better Responsiveness

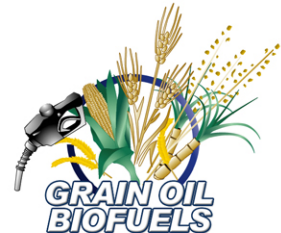


# Vitality Signal

Yeast Activity Monitor

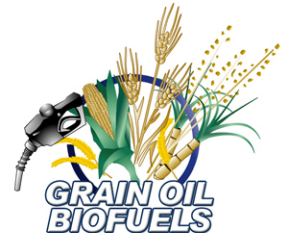


Viable Yeast Count



# Yeast Activity Monitor Summary

<p style="text-align: center;"><b><u>Equipment</u></b></p> <ul style="list-style-type: none"><li>• Dedicated Digital Balance</li><li>• 1-4 Triple Sensor Probes</li><li>• Turbidity and Temperature</li><li>• Color HMI Touch Screen</li><li>• Network Ready</li></ul>	<p style="text-align: center;"><b><u>Software</u></b></p> <ul style="list-style-type: none"><li>• Dedicated OS &amp; Programs</li><li>• Login Level Access Control</li><li>• Rich sample descriptions.</li><li>• Automated measurements.</li><li>• Automatically logs all data.</li></ul>
<p style="text-align: center;"><b><u>Reagents</u></b></p> <ul style="list-style-type: none"><li>• Room Temp Storage</li><li>• Long Shelf-life Stability</li><li>• Fast Reaction Rates</li><li>• Easy to Dispense</li><li>• High Signal, Low Background</li></ul>	<p style="text-align: center;"><b><u>Overall</u></b></p> <ul style="list-style-type: none"><li>• Improved sample handling.</li><li>• Semi-automated process.</li><li>• &lt; 30 second sample prep.</li><li>• Real-time data availability.</li><li>• Versatile and easy to use.</li></ul>



# Potential Benefits in Biofuels

---

1. Use the technology to establish accurate activity profiles during normal, stressful, and rebuilding periods in continuous or batch fermentation processes.
2. Use the profiling capabilities to
  - define ideal operating conditions,
  - identify major process upsets earlier,
  - assist operations during slowdown/shutdown/startup,
  - optimize biological process operations.
3. Explore new process conditions (temperature profiles, enzyme and nutrient additions, bacterial control practices, etc.) and optimize conditions to promote optimal growth and metabolism while always being confident in the activity measurements.