UGMA Compatible Moisture Meter Update

GRAIN INSPECTION ADVISORY COMMITTEE

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United States Department of Agriculture

GIAC Topics

- DICKEY-john modification
- Condensation Effects on Moisture and Test Weight
- Assess UGMA compatible moisture meters for test weight

DICKEY-john Modification

- Approved new temperature sensor design
  - NTEP
  - GIPSA
- All 502 official meters being upgraded
  - Coordinating with DICKEY-john to avoid disruption in service

Condensation effects

July 2014 Resolution -

It is known that moisture condenses onto cold grain. Because of the possible propensity for cold grain pneumatically delivered from a sampler to an inspection laboratory in a warm humid atmosphere to result in an apparent decrease in the TW result and an apparent increase in the moisture result, the Advisory Committee recommends that FGIS study this issue with an eye to finding a way to correct the results of measuring the two factors to account for this phenomenon.

Condensation effects

Condensation effects

- Research
  - 1996 Elevator Study in New Orleans
  - 1997 – 1998 Laboratory Study in Kansas City
  - 1998 Elevator Study in New Orleans
  - 2014 Elevator Study in New Orleans

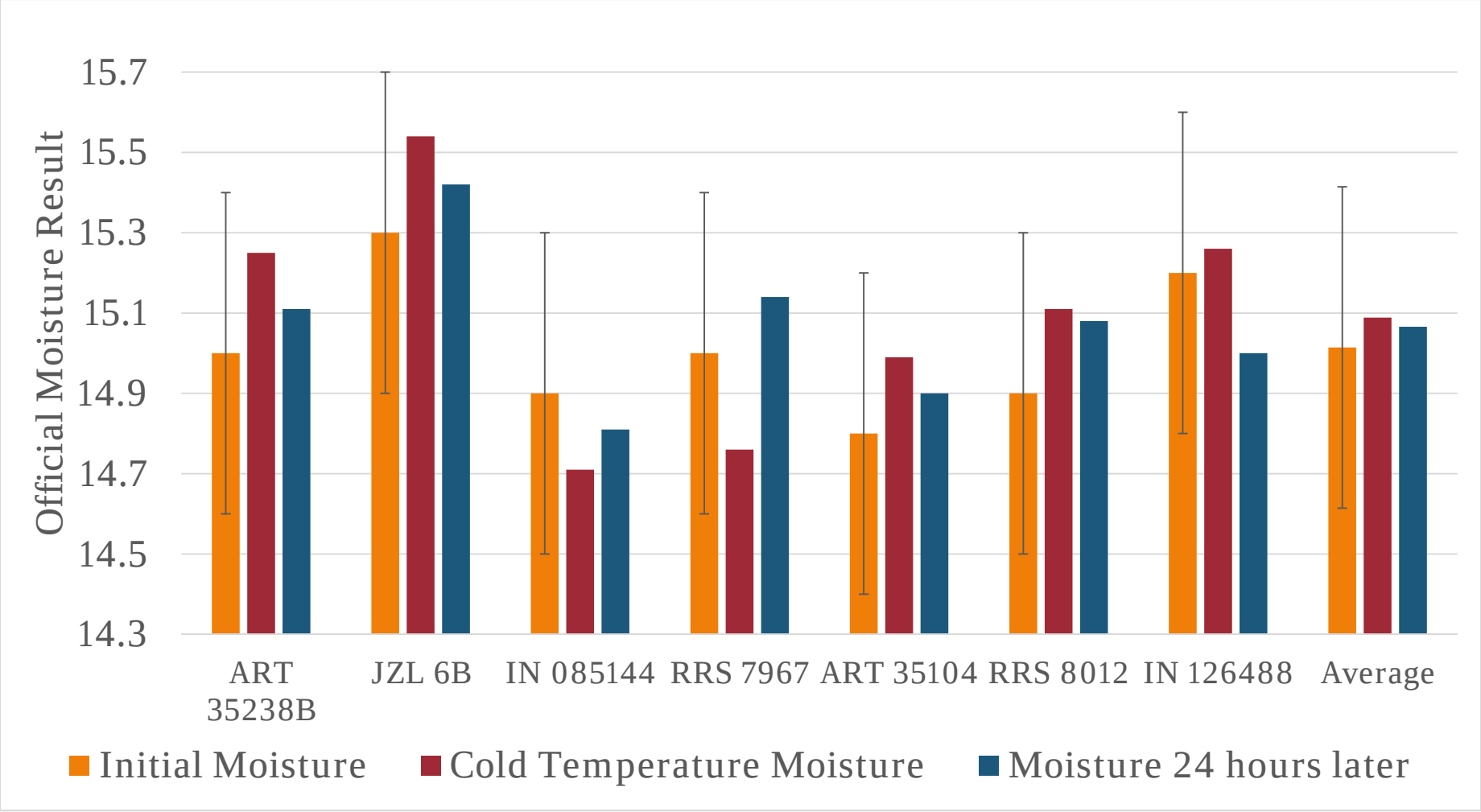
Moisture Conclusions from 1996 - 1998

- Observed moisture gains within limits of thermodynamics (maximum amount possible moisture gain)
- Moisture meter accuracy not significantly affected by moderate condensation
- Potential for small moisture increase (maximum +0.3) under extreme condensing conditions achieved in lab
  - Within moisture measurement variability (+/- 0.4 SIMS tolerance)
- Elevator tests did not show observable moisture changes due to condensation

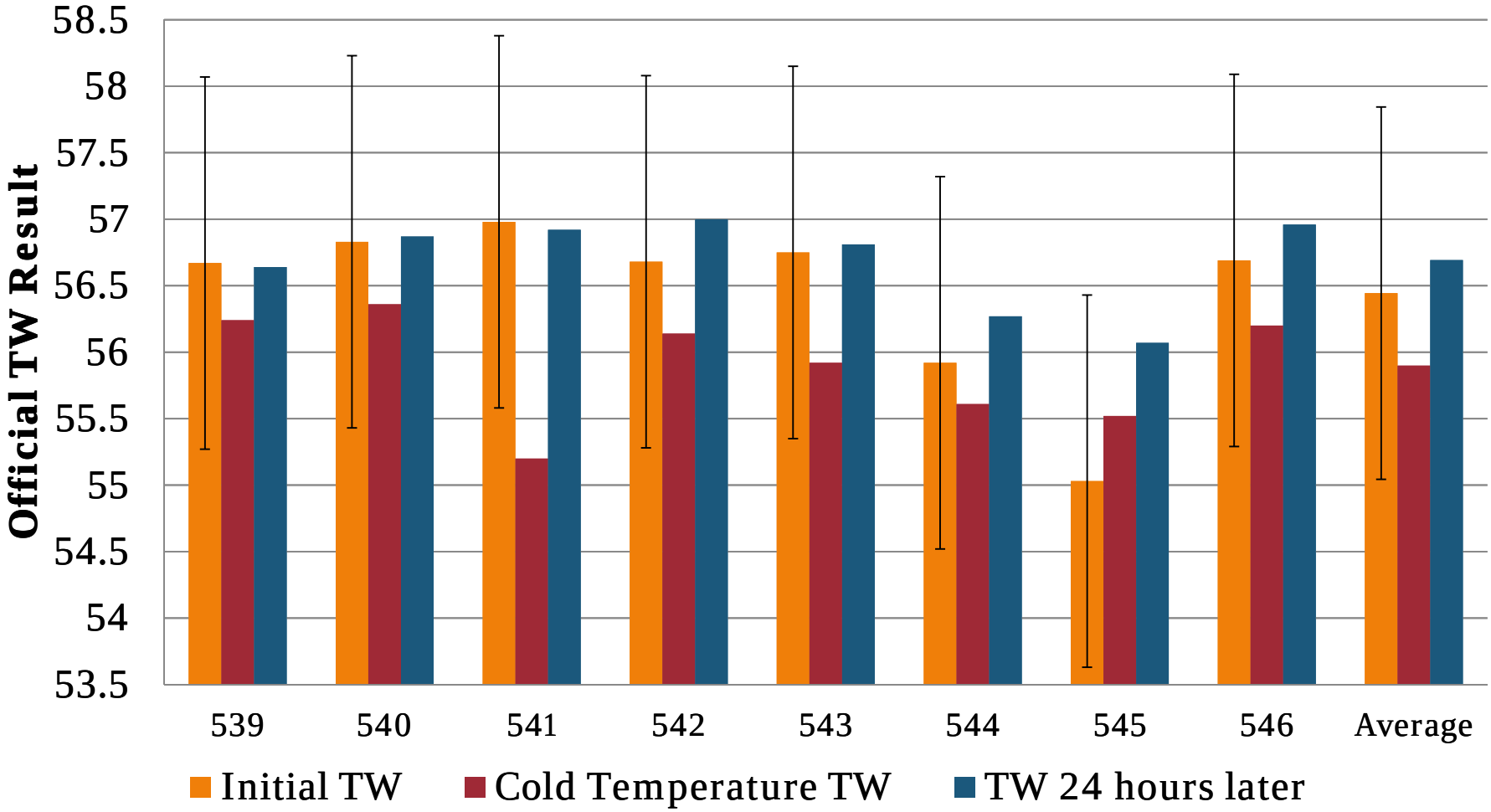
Test Weight Conclusions from 1996 - 1998

- Potential for changes to Test Weight during sample transport
  - Under non-condensing conditions tended to increase
  - Under condensing conditions tended to decrease
- Test Weight significantly affected by condensation
  - Decrease average 1.67 lb/bu under extreme condensing conditions
  - After equilibration Test Weight partially recovered the loss due to condensation
- Elevator studies did not duplicate lab TW losses presumably due to non-condensing conditions present

2014 Corn Moisture Samples



2014 Soybean Test Weight Samples



Variables required to develop corrections for condensation effects

Moisture Variables	Additional Test Weight Variables
• Grain Temperature • Sample delivery air temperature • Sample delivery air dew point • Time in sample delivery system • Air flow in sample delivery system	• Changes under non-condensing conditions due to specific sample delivery system • Seed coat characteristics (texture) • Prior handling of sample • Sample cleanliness

Condensation effects

- 2014 Study in New Orleans confirmed 1998 laboratory results
- Unlikely that condensation responsible for large moisture and test weight changes
- Possible future work should focus on grain delivery system

UGMA Meters - Test Weight

July 2014 Resolution –

Whereas the Test Weight module/apparatus that is integrated in the current official moisture meters is capable of testing for the test weight of grain; the Advisory Committee recommends that GIPSA complete and report its research regarding the feasibility of changing the official method for determination of test weight from the kettle method to the test weight apparatus integrated in the official moisture meters.

UGMA Meters - Test Weight

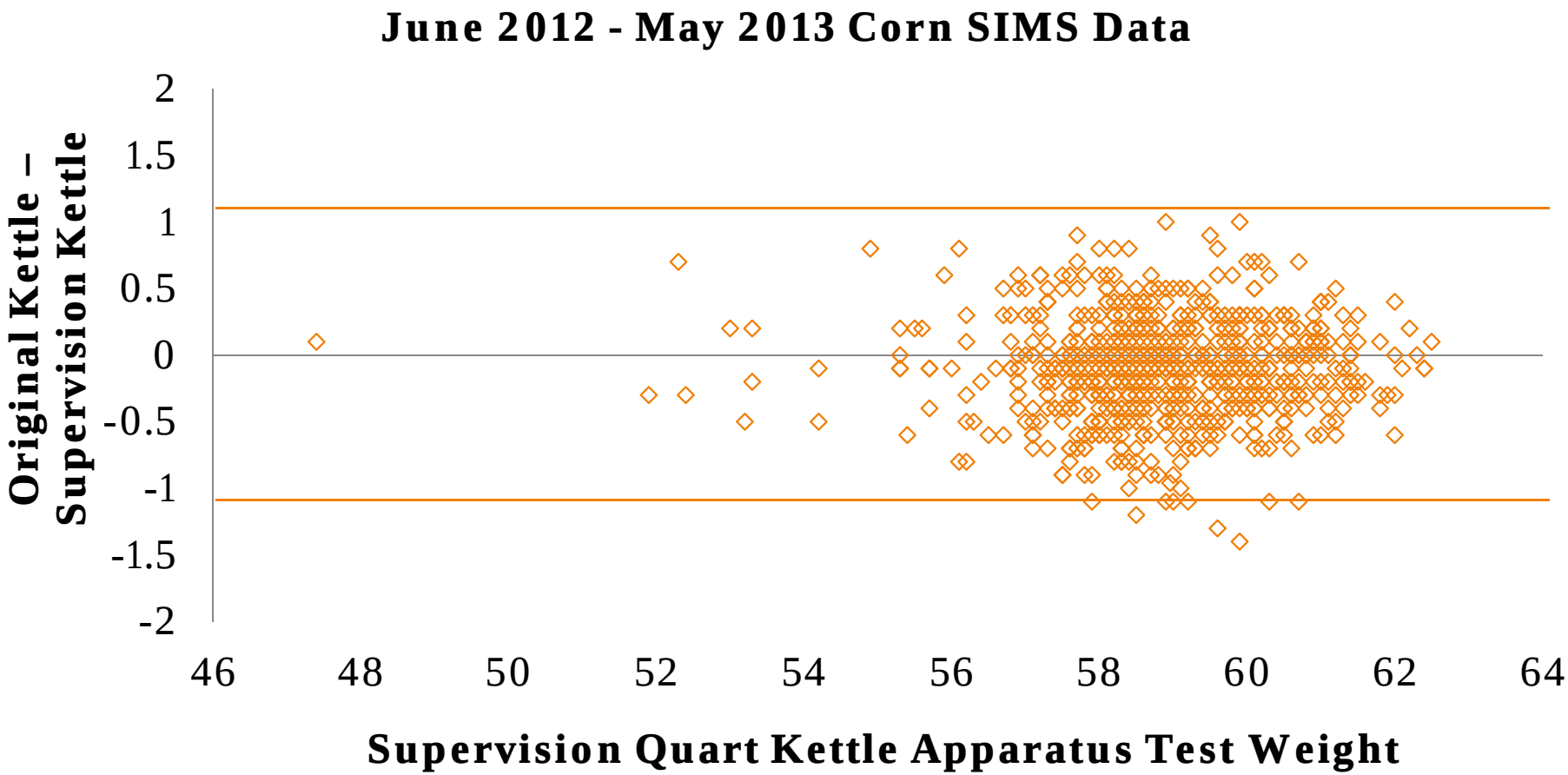
- General indicator of grain quality
- Determines throughput for volume-limited processes
- Determines volume required for shipping containers
- Used to estimate grain handlers' inventories
- Relative importance of these factors varies by grain and is probably reflected in Basis of Determination.

GIPSA-Certified UGMA-Compatible Moisture Meters with TW Capability

- Dickey-john
  GAC 2500UGMA

- Perten
  AM 5200-A

Corn SIMS Data

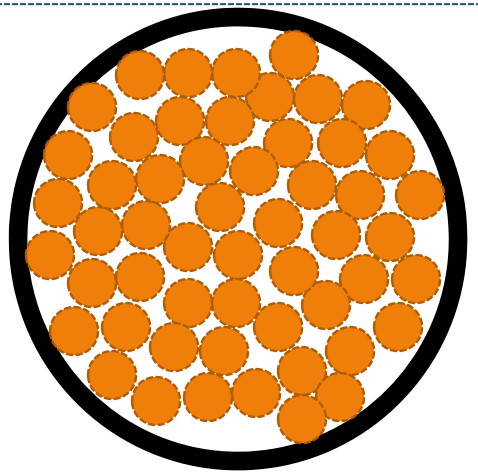


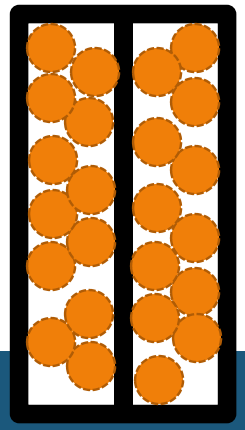
Bases of Determination

Group	Grade-Determining	Moisture	Test Weight
Barley	Yes	With dockage	Remove dockage
Corn	Yes	With BCFM	With BCFM
Oats	Yes	With FM	With FM
Rough Rice	No	With dockage	With dockage
Sorghum	Yes	With dockage	With dockage
Soybeans	No	With FM	With FM
Sunflower Seed	Yes	With FM	Remove FM
Wheat	Yes	With dockage	Remove dockage

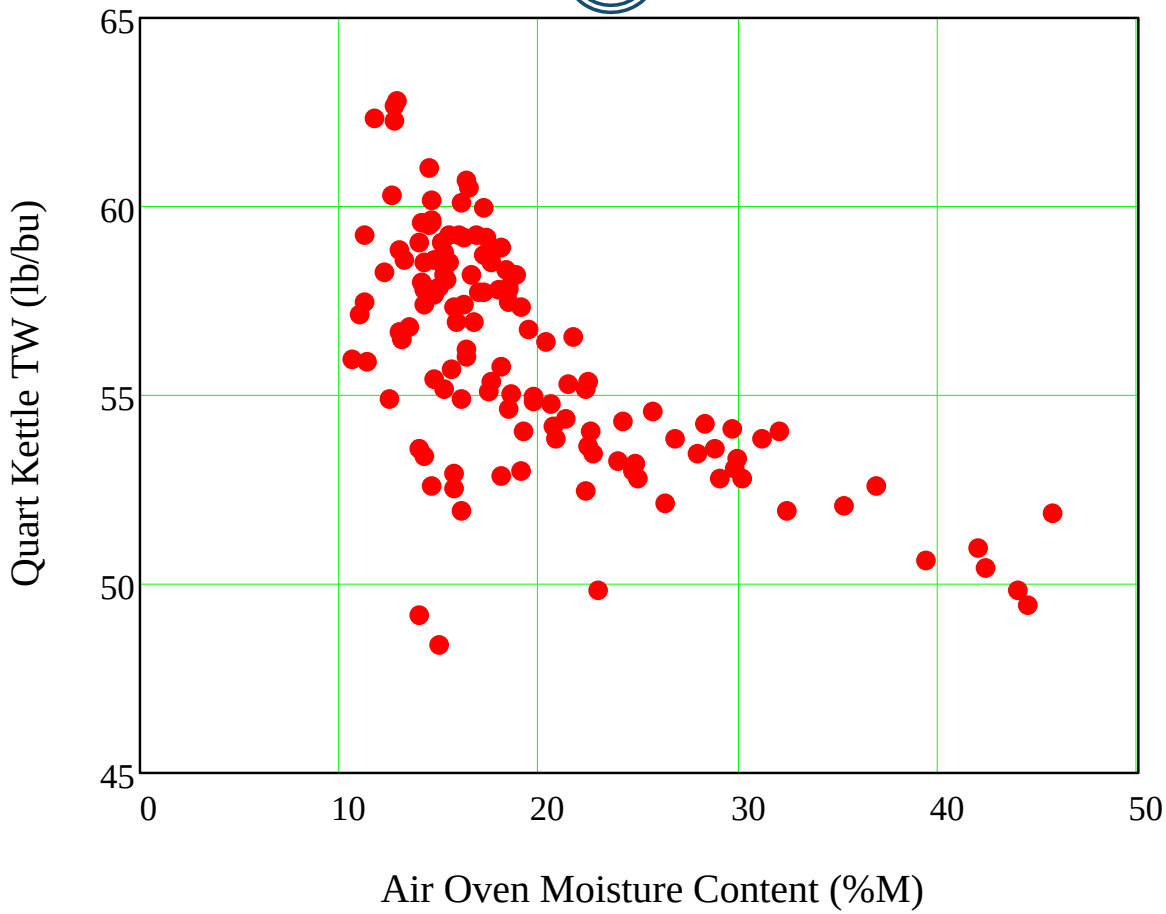
Quart Kettle and UGMA-based TW - not "Technically Equivalent"

- Vessels are significantly different in shape and size
  - Different surface area to volume ratios
- Filling and strike-off are different
- Moisture meters require grain-specific mathematical adjustments to agree *on the average* with official test weight.
- Optimum adjustments depend on many factors that may not be stable over time or regions.
- Sample-to-sample differences may be large.



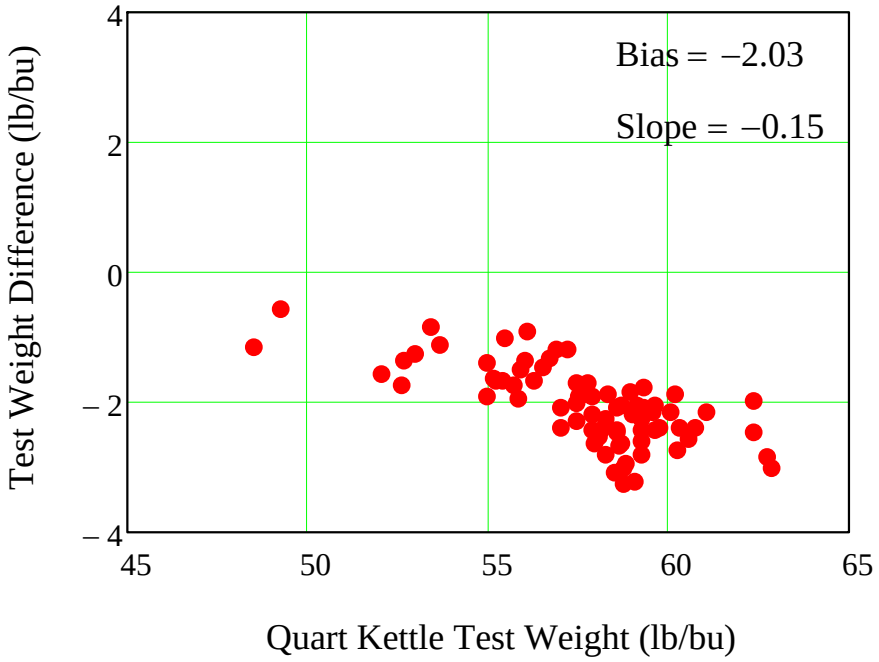


Drastic Effects of Moisture on Test Weight Corn

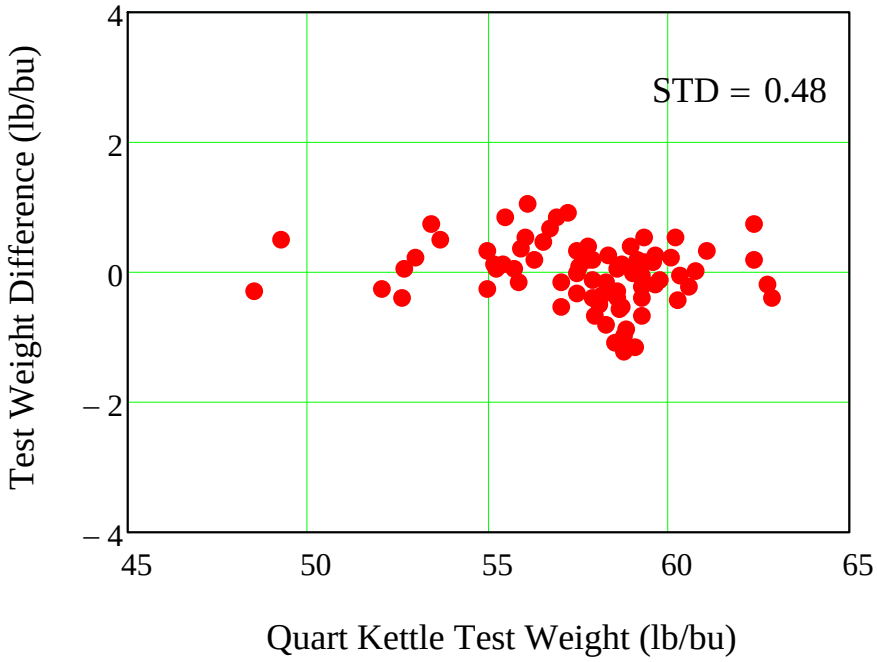


UGMA-Based TW Adjustments for 2012 Crop Corn (M<18%) Samples

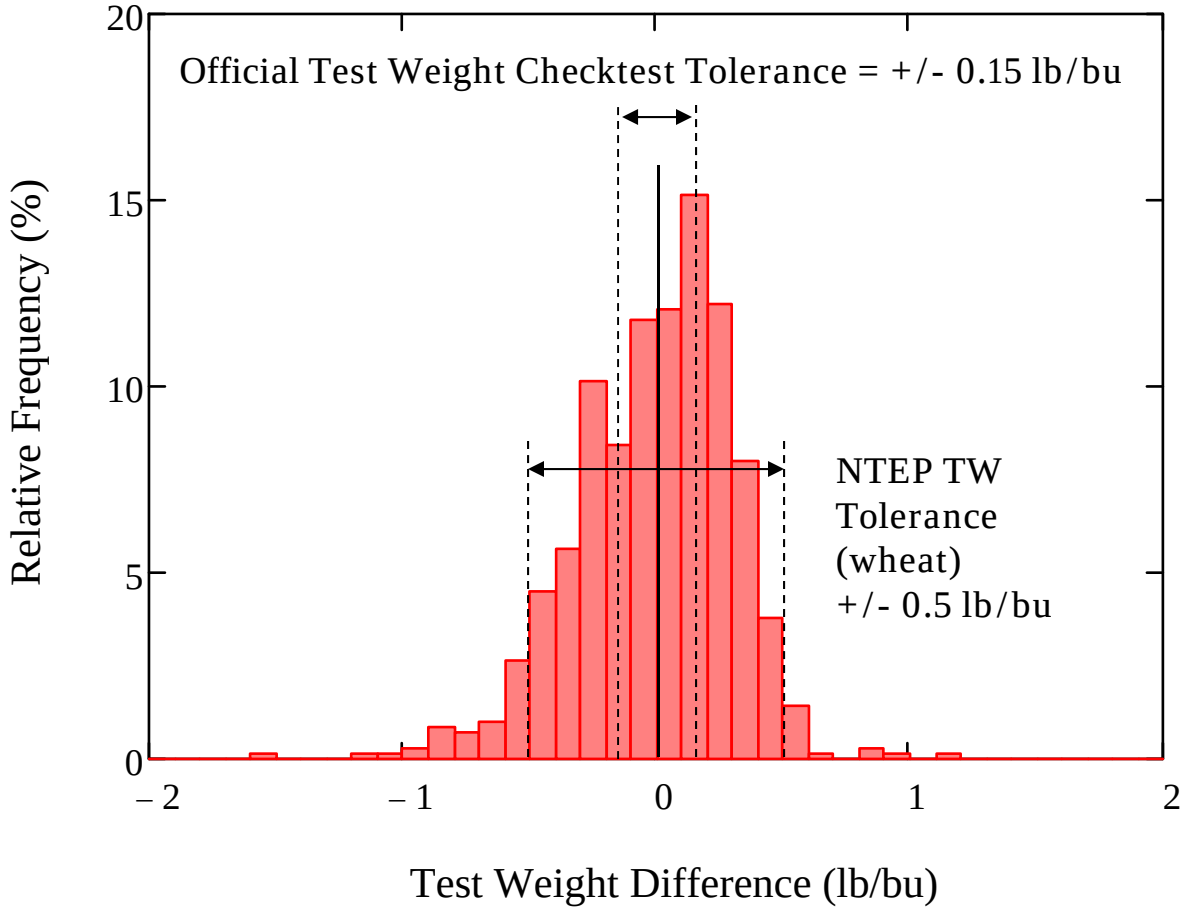
Unadjusted



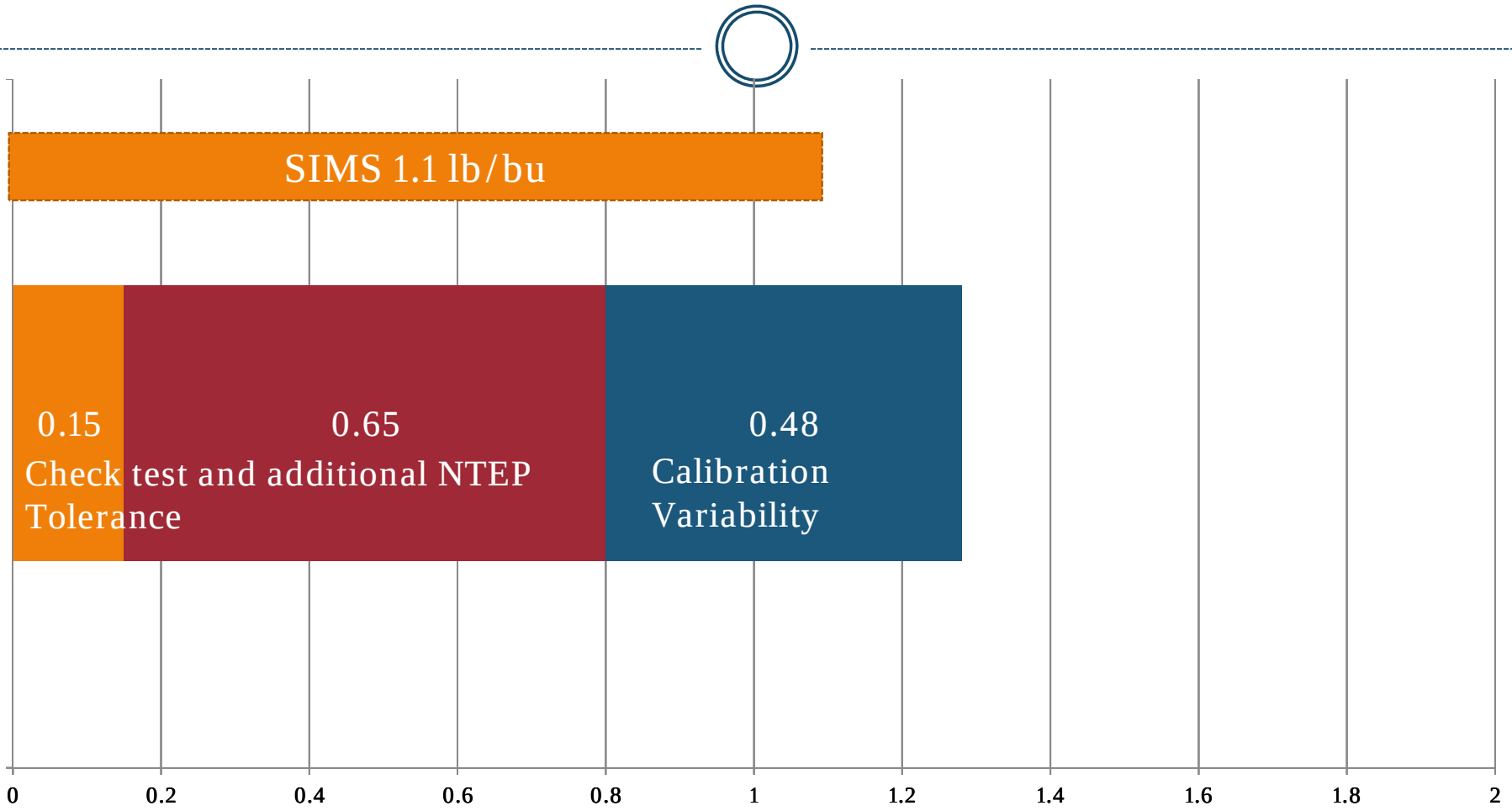
Adjusted



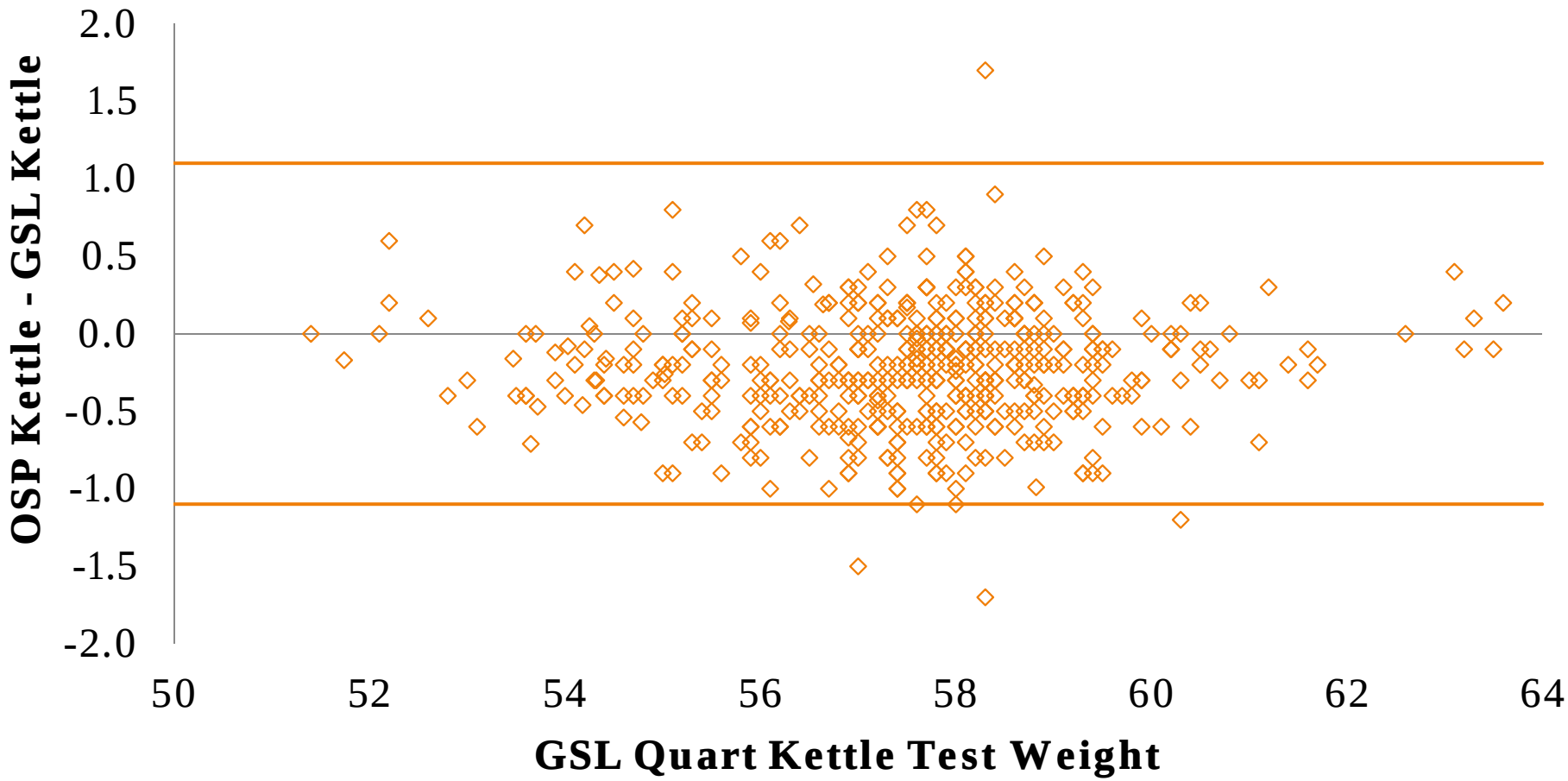
Distribution of Mean Differences from HQ Standard UGMA Moisture Meter TW



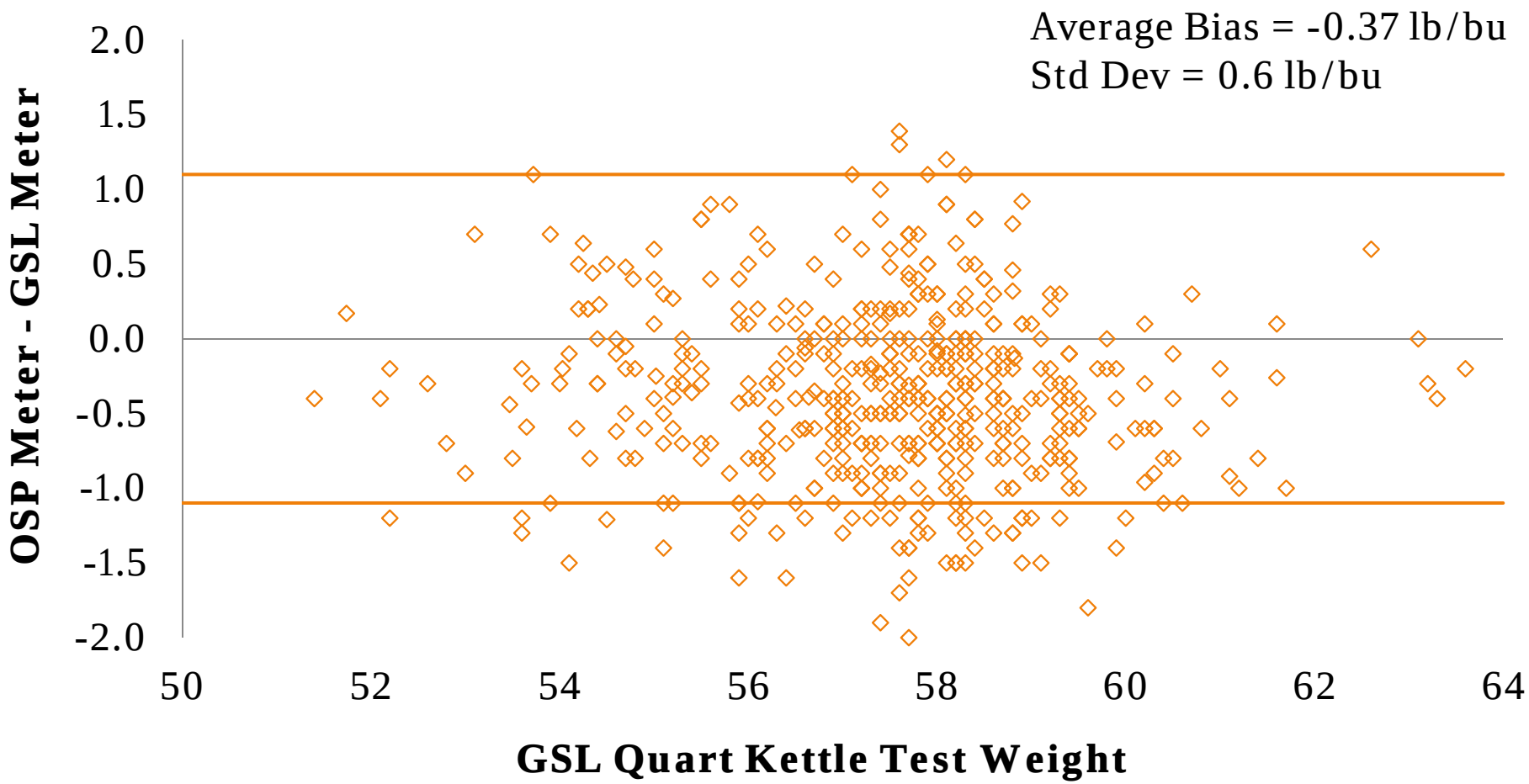
Corn Tolerance –Kettle/MM



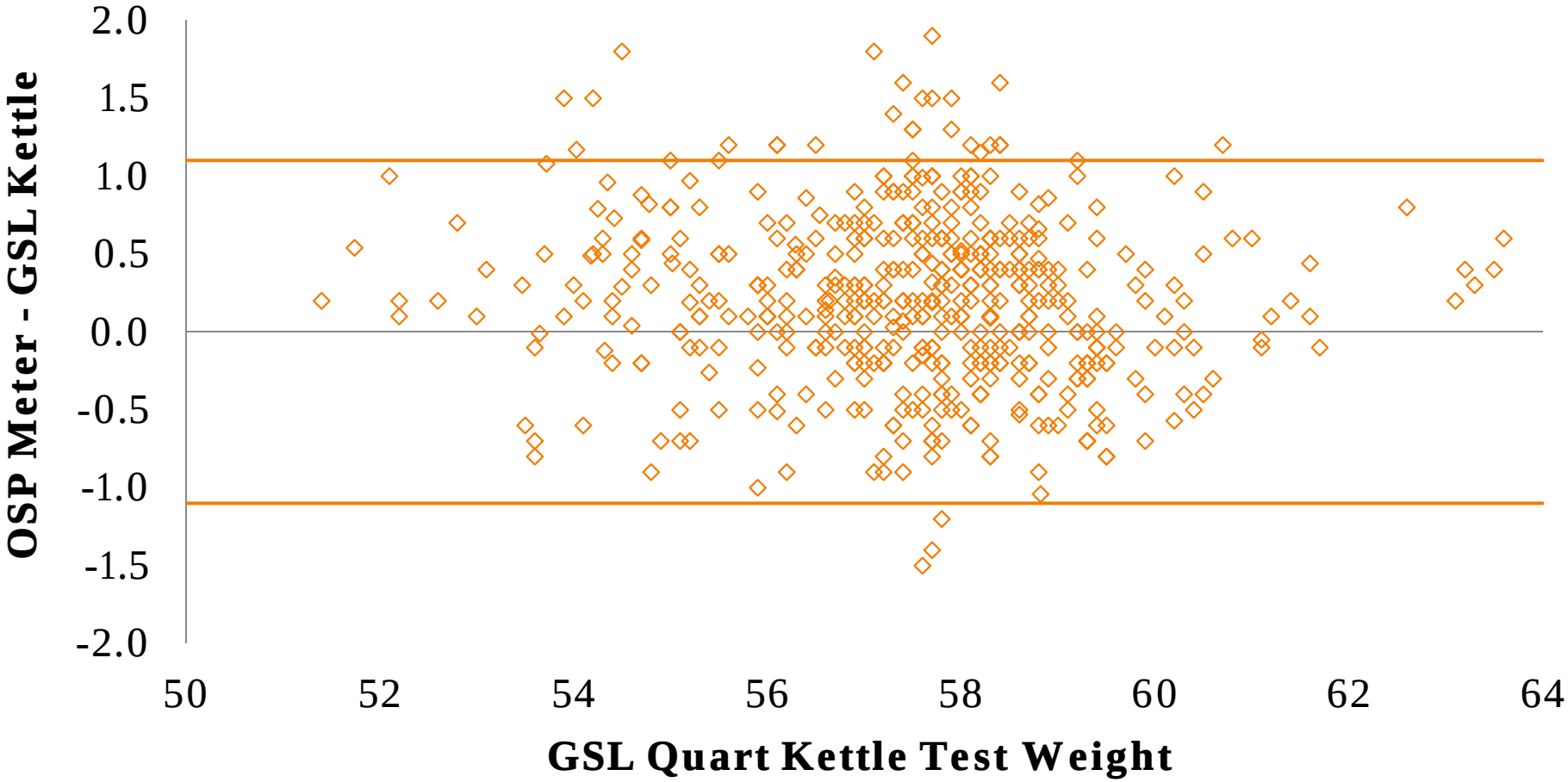
2014 Corn Enhanced Moisture Monitoring Quart Kettle to Kettle TW Data



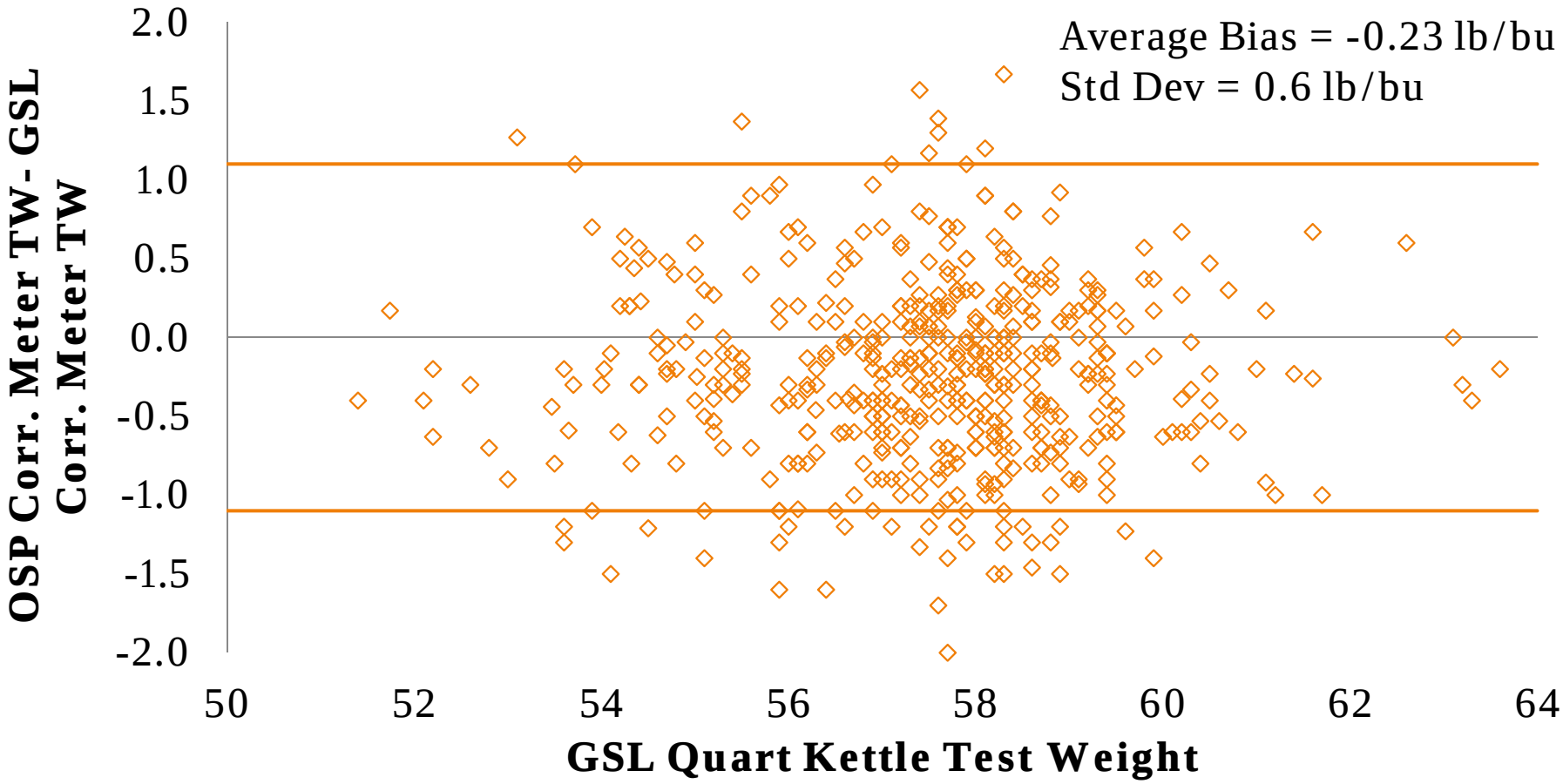
2014 Corn Enhanced Moisture Monitoring Meter to Meter TW Data



2014 Corn Enhanced Moisture Monitoring Meter to Kettle TW Data



2014 Corn Enhanced Moisture Monitoring Meter to Meter Bias Corrected TW Data



If UGMA Meters Used for Test Weight

- Need to remove or minimize impact of barriers
- Modify Check Test procedures and tolerance
- Improve adjustment factors to align meters to quart kettle
- Improve agreement between models
- Are the current SIMS tolerances reasonable expectations?
  - Is it acceptable for corn to potentially vary by +/- 1.8 lb/bu?

Questions? Comments?