Falling Number
Rhonda Lyne | Physical Scientist
Technology and Science Division | FGIS | AMS | USDA

Prairie Grains Conference
December 12, 2019

Link to our video in the presentation: https://www.ams.usda.gov/resources/video-library
Falling Number (FN) Method

- Indirect measurement of alpha-amylase activity
- Alpha-amylase breaks down starch
- High activity adversely effects end-use quality
- Important factor in domestic and international trade of wheat (not official grading factor)
- Internationally standardized and most widely accepted method
- FN is the time required to mix and drop rod through heated wheat meal / water slurry
- FN inversely proportional to alpha-amylase activity
Improvements to Falling Number Test

• FGIS implemented two improvements May 1, 2019

• FN Directive 9180.38
  • Correction to sea level using barometric pressure
  • Requirement of Shakematic use

• Better alignment between labs

• Promote fair trade

• Falling Number video online
  • https://www.ams.usda.gov/resources/video-library
Correcting FN to Sea Level

• Increase in elevation leads to increase in FN

• Previous FGIS procedure
  • Correct to sea level at locations 2000 ft. and above
  • Cereal Chem. 1994, 71(3), 269–271
  • Correction needed below 2000 ft. to remove bias

• New FGIS procedure
  • FGIS engaged USDA Agricultural Research Service
  • Correct to sea level using barometric pressure
  • Cereal Chem. 2018, 00, 1–8
Effect of Elevation on Falling Number

Example: FN = 300 sec at sea level

Barometric Pressure (in Hg)

<table>
<thead>
<tr>
<th>Elevation (ft.)</th>
<th>Predicted FN (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland, OR</td>
<td>300</td>
</tr>
<tr>
<td>Kansas City, MO</td>
<td>312</td>
</tr>
<tr>
<td>Devil’s Lake, ND</td>
<td>330</td>
</tr>
<tr>
<td>Great Falls, MT</td>
<td>350</td>
</tr>
</tbody>
</table>

- +12 sec
- +18 sec
- +37 sec
Sample Shaking Method

• Sample / water homogenization required

• FGIS allowed shaking by hand or Shakematic

• FGIS compared the two shaking methods

• FGIS now requires Shakematic
  • Eliminates fatigue
  • Provides more consistent mixing
  • Most official service providers used Shakematic
Falling Number Monitoring Program

• Official Service Providers (OSP) are required to submit one sample/instrument each week

• FN Directive 9180.84

• Technology and Science Division (TSD) tests the samples

• TSD and OSP data are graphed
  • Established limits for data, look for bias
  • Relative Difference (OSP result-TSD result/TSD result *100)
  • Work with OSP when issues are seen (email, phone, site visits, training at TSD)
  • Require validation of new or repaired instruments
Falling Number Monitoring Program

% Relative Difference

Sample ID

AL

WL

F-52
F-145
F-177
255
Falling Number Check Sample Program

• Every six months TSD sends out four check samples
• OSP test the samples
• OSP and TSD data is compiled and compared
  • Report generated
  • Shows OSP how they compare to others and overall AVG
• Overall RSD generally below 5% for ~52 instruments (SD/Mean*100)
Falling Number

- Perten, the FN manufacturer, recommends that repeated tests on the same sample within the same laboratory should agree within +/- 5% of the average FN value.

- Official FGIS results are tested in duplicate and must pass the 5% rule (unless over 400 seconds).
Falling Number Retest and Appeal

• A retest and/or appeal inspection is available upon request by the applicant.

• A retest inspection may be performed by the same office that performed the original inspection.

• An appeal inspection, when requested by the applicant, may be performed by an FGIS field office, TSD, or Federal/State office that monitored the office that performed the original inspection or retest.

• DIOO (Domestic Inspection Operations Office)
Area Official Service Providers

• North Dakota Grain Inspection (Fargo, ND)
• Northern Plains Grain Inspection (Grand Forks, ND)
• Grain Inspection Inc. (Jamestown and New Salem, ND, Appleton, MN)
• Montana State Grain (Great Falls, MT)