

A Robust Quality Assurance, Troubleshooting, and Reporting Protocol for Near-Infrared Reflectance Spectroscopic Forage Testing



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Introduction

Forage quality has valuable and practical considerations for animal nutritionists and livestock entrepreneurs; and forage producers, hay brokers and others using forage quality to set the selling price. Near-Infrared-Reflectance-Spectroscopy (NIRS) provides an accurate, less expensive alternative to “wet chemistry” for forage analysis, while reducing time and eliminating hazardous chemicals. However, its success depends on the development, and implementation of a robust quality assurance protocol along with rigorous monitoring, evaluation and troubleshooting of predicted forage quality attributes.

In our Feed and Forage testing laboratory, we developed and implemented a comprehensive protocol for sample processing, testing, quality assurance, and the reporting of various types of forage analyses by NIRS, which fulfills the above requirements.

The Basics of NIRS QA Protocol at UGA Forage Testing Laboratory

The quality assurance protocol essentially relies on its seven foundation pillars:

The QA Structure

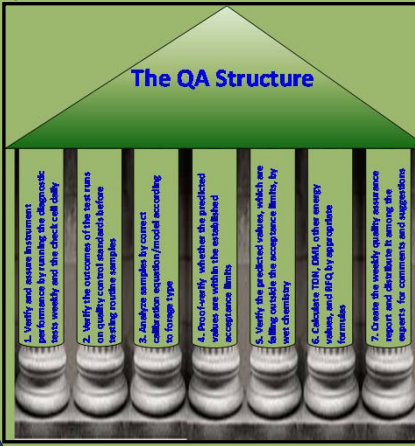


Figure 1: Foss NIRSystems 6500



Figure 2: Diagnostic test results

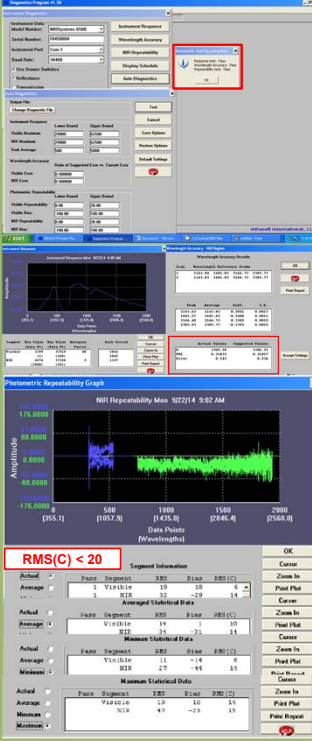
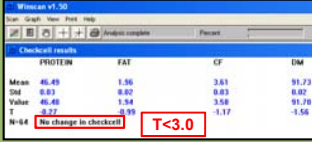


Figure 3: Check cell run results



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FORAGE TESTING BY NEAR INFRARED REFLECTANCE SPECTROSCOPY

NIRS Laboratory Weekly QA Reporting Protocol (Revised on 04/02/2014)

The following NIRS QA samples will be analyzed each week effective 09/12/2014 with better values. NOTE: All values in the table below are sample means. As the number of samples with lower DM and CP values will be available in any sample type, this protocol will be revised by replacing the other QA samples with the lowest DM and CP values, and the lowest protein will be reported to management weekly, with the following message:

NFTA File	Day of Testing	CP (%)	DM (%)	CP	DM	CP	DM	CP	DM	CP	DM	CP	DM	CP	DM
2012-01-01	Monday	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0
2012-01-02	Tuesday	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0
2012-01-03	Wednesday	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0
2012-01-04	Thursday	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0
2012-01-05	Friday	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0

AN EXAMPLE OF WEEKLY QA REPORT

28 QC samples analyzed between 09/12/2014 and 09/18/2014

Parameter	Score	Grade
Dry Matter (DM)	4.0	A
Protein (CP)	3.3	B
Acid Detergent Fiber (ADF)	3.7	A
Neutral Detergent Fiber (NDF)	3.8	A
Weekly Score	3.7	A

CONTROL CHART

Weekly Grade Point Average

NIR QC Summary Period 2014 Week Ending

Weekly Schedule of QC Samples

- Run two NFTA QA QC samples each day as assigned in weekly QA protocol.
- Run at least one QC sample representing each forage type to be analyzed.

Weekly QA Report

- Weekly QA report summarizes the performance for a week: Friday to Thursday.
- Generally, 15-30 QC samples are run in a weekly reporting period.

Control Chart

- Continuously extend the control chart with the weekly grade point averages (GPA).
- Troubleshoot if GPAs diminish below the Warning Limit (mean – 2xsd) and/or Action Limit (mean – 3xsd).

Outcomes

This robust QA protocol led our NIRS forage analysis program to a substantially improved level for producing authentic, useful, and defensible results, which has had several positive impacts:

- We believe this has reduced our error rate down to less than 1%.
- Without this protocol, human error could produce incorrect results. This could cause underestimation or overestimation of forage quality in some cases, and consequently a lower or higher value for the forage marketer's product. It could also cause the livestock producer to purchase and use an incorrect amount of supplemental energy sources.
- In some instances, incorrect forage analysis could cause the producer/user to suffer significant economic losses.