



Evaluating Hand-Held NIRS Units for Measuring Forage Quality of Fresh-Chopped Alfalfa and Alfalfa Hay and Haylage

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RATIONALE & OBJECTIVES

- Handheld near infrared reflectance (NIR) instruments are now available for non-scientist operators for on-farm evaluation of forages with different detector technologies and greatly different NIR scanning ranges. However, there has been no independent evaluation of their relative effectiveness in the field.

Objectives:

To assess the magnitude of day-to-day alfalfa haylage variation, and evaluate several hand-held NIR instruments for precision and accuracy of currently available calibrations.

STUDY DESCRIPTION

Instrument functionality:

Over 600 dry ground alfalfa samples were used to evaluate the relative success of handheld NIR instruments compared to a laboratory NIR instrument.

Haylage variability:

A total of 375 alfalfa and alfalfa-grass haylage and total mixed ration (TMR) samples were collected from 19 dairy farms in NY and WI during 2019 and 2020. This included 24 weeks of daily haylage sampling from 7 NY farms. Wet chopped samples were scanned with an AuroraNir, an NIR4, and a SCiO handheld NIR units (with Cargill REVEAL calibrations), as well as being evaluated for moisture with an HST-1 electronic impedance probe.

Precision:

Precision estimates for dry matter (DM) were obtained by scanning samples 10 times with remixing. All samples were oven dried and analyzed via wet chemistry in duplicate.

Accuracy:

Accuracy of instruments was assessed based on the root mean square error of prediction (RMSEP), residual prediction deviation (RPD) and the ratio of RMSEP to the range of reference values (RER).

RESULTS

- Assuming a 7% unit threshold for a weekly range in DM is great enough to benefit from daily ration rebalancing, this threshold was exceeded 42% of weeks for alfalfa haylage.
- Handheld NIR instruments with a scanning range up to 1650 nm can work effectively with dry ground alfalfa samples.
- The AuroraNir and NIR4 instruments, with a similar NIR scanning range, were similar in precision for estimating oven DM, while the SCiO and HST-1 instruments were less precise.
- Using currently available calibrations, accuracy of DM estimations was in the order of AuroraNIR > NIR4 >> SCiO >> HST-1.

CONCLUSIONS/SUGGESTIONS

- Current DM calibrations for all NIR systems observed were not sufficiently robust for a range of mixed haylage and TMR samples from NY and WI.
- Calibrations for the AuroraNir did not produce consistently accurate results for nutritive value determinations, particularly when dealing with alfalfa-grass haylage.

Figure 1. Typical alfalfa spectra. LAB = FOSS 6500, DA = AuroraNir, SW = SCiO. The NIR4 spectrum (not shown) is very similar to Aurora.

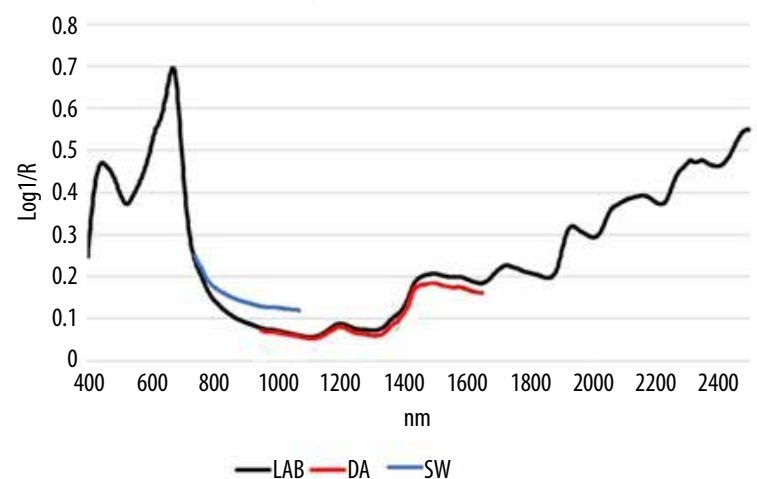


Figure 2. Weekly range in alfalfa and alfalfa-grass haylage dry matter (DM) over 24 weeks of daily bunker sampling from 7 NY farms, sorted smallest to largest weekly range.

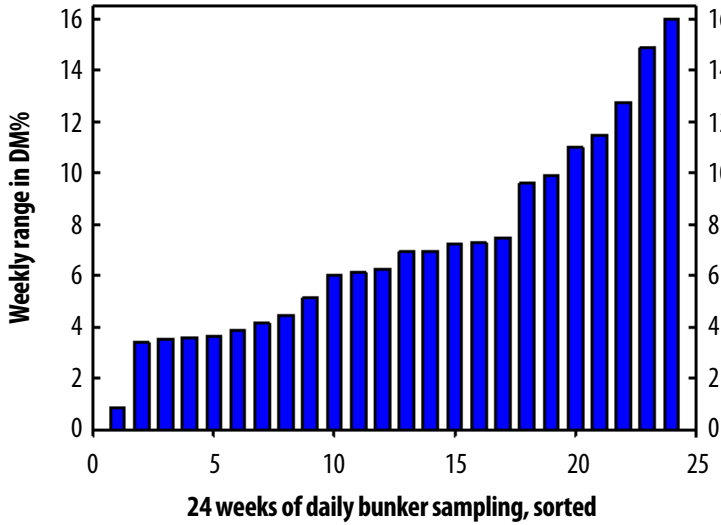


Figure 3. AuroraNir and NIR4 DM estimates compared to oven DM for alfalfa haylage (red) and total mixed rations (TMR, green).

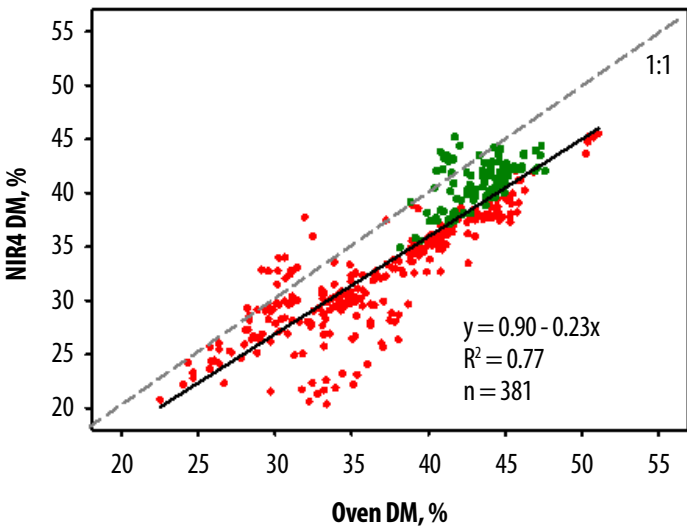
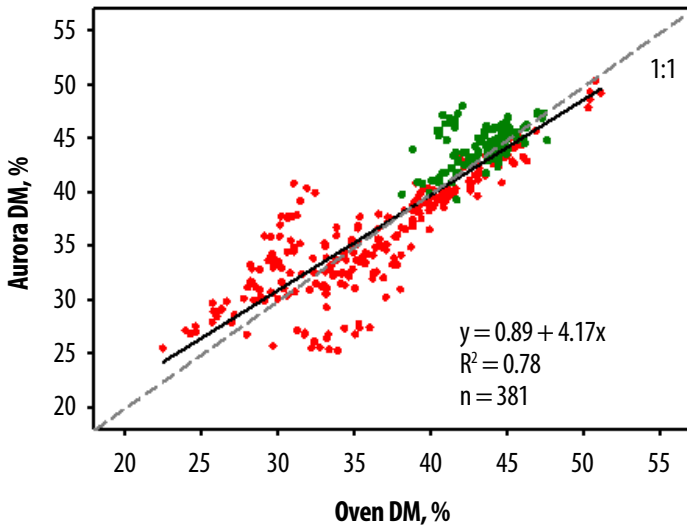


Figure 4. SCiO NIR and HST-1 electronic moisture probe estimates compared to oven DM for alfalfa haylage.

