



There's An App for That! Validating Real-Time Assessment of Alfalfa Nutritive Value

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RATIONALE & OBJECTIVES

- Having the power of a portable NIRS would allow for immediate, in-field analysis of forage nutritive values and provide a critical piece of technology for the forage and livestock sectors.
- No hand-held NIRS technologies marketed for farmers were currently programmed to assess alfalfa forage nutrient values.

Objectives:

To develop equations for prediction of nutritive values of fresh or green chopped alfalfa forage using a hand-held NIRS unit.

STUDY DESCRIPTION

Location:

University of Minnesota – St. Paul, MN.

Factors:

- Alfalfa was hand harvested from a field planted in 2017 that contained three varieties, 'Magnum 7', '440HVX.RR', and 'SW4107'. Alfalfa herbage samples were collected to a 3 cm stubble height starting on 10 June 2019 when alfalfa was in the late vegetative stage and continued every 7 days until the alfalfa reached full flower. Additional samples were collected from regrowth during second cutting starting when alfalfa was in the late vegetative stage and continued every 7 days. A total of 100 samples were collected over both sampling periods. Individual fresh samples, chopped to 2.5 (n=80) and 1 cm (n=20) lengths, were scanned by a NIR4 Farm handheld unit (Figures 1 and 2). After scanning, samples were dried, ground, thoroughly mixed, and sent to a commercial laboratory for wet chemistry analysis to determine crude protein (CP), acid detergent fiber, neutral detergent fiber (NDF), and NDF digestibility (NDFD48).

Analysis:

Laboratory wet chemistry analyses were used with spectra collected by the NIR4 Farm unit to develop calibration equations for fresh or green chopped

alfalfa. Calibration statistics include the coefficient of determination (R^2), standard error of calibration (SEC), and standard error of cross validation (SECV). The best NIRS calibration equation consider all three statistics, but preferably have R^2 values greater than 0.60 with small SEC and SECV values.

Figure 1. NIR4 Farm (AB Vista, Marlborough, England) hand-held NIR unit (A, NIRS probe; B, NIRS tablet; C, scanning bowl). *Photo credit: Jessica Prigge, UMN.*

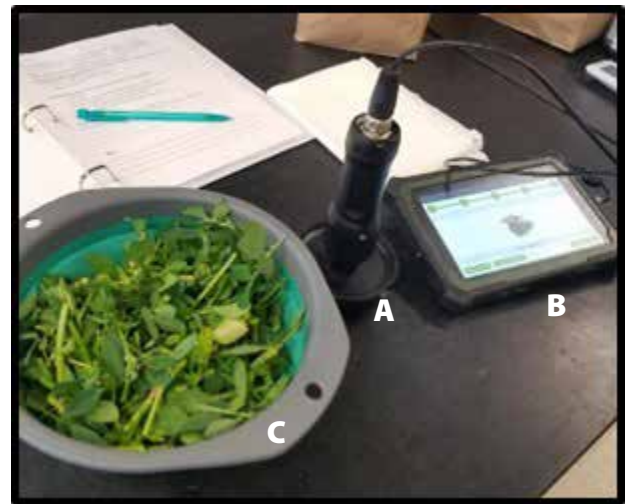


Figure 2. Scanning a dried alfalfa samples using the NIR4 Farm hand-held NIR unit. *Photo credit: Liz Patton, UMN.*



RESULTS

- The NIR4 Farm unit was able to accurately predict all major forage nutritive value components except non-fiber carbohydrates (NFC) and NDFD48 (Table 1).
- General observations were made regarding chopping time, scanning time, and battery life. Chopping samples to a 2.5 cm length took 3 minutes per sample, while chopping to the 1 cm length took 10 minutes. It took 1 minute to scan each sample and the battery lasted seven to eight hours on a full charge, and recharged within two hours.

CONCLUSIONS/SUGGESTIONS

- This research showed that the NIR4 Farm unit has the capacity to be effectively used on farm, potentially saving livestock owners and forage producer both time and money by providing accuracy and flexibility.
- Future research should continue to developed calibration equations for hand-held NIRS units that can be used with different alfalfa forage types (e.g. dried alfalfa hay, alfalfa haylage, and alfalfa baleage).

Table 1. Summary of NIR4 Farm calibration statistics for prediction of moisture and forage nutritive values of fresh or green chopped alfalfa.

Components*	N [§]	Mean	SD	SEC	R ²	SECV	Acceptable
Moisture	100	9.58	0.66	0.341	0.733	0.374	Y
DM	100	90.43	0.66	0.348	0.718	0.376	Y
CP	100	23.11	3.63	1.449	0.841	1.559	Y
NDF	100	36.63	4.07	2.320	0.676	2.456	Y
NFC	100	28.13	2.35	1.591	0.542	1.689	N
TDN	100	65.48	2.08	1.312	0.603	1.373	Y
NEL	100	0.69	0.03	0.020	0.638	0.020	Y
NEM	100	0.66	0.04	0.021	0.650	0.022	Y
NEG	100	0.39	0.03	0.020	0.619	0.021	Y
IVTD48	100	81.23	3.28	2.055	0.607	2.200	Y
NDFD48	100	49.15	4.62	3.649	0.375	3.846	N
ME_lb	100	1.10	0.05	0.022	0.789	0.024	Y
ME_kg	100	2.43	0.11	0.048	0.796	0.054	Y
TDN1X	100	60.95	1.49	0.877	0.653	0.915	Y

*DM, dry matter; TDN, total digestible nutrients; NEL, net energy for lactation; NEM, net energy for maintenance; NEG, net energy for gain; IVTD48, in vitro digestibility at 48 hours; NDFD48, neutral detergent fiber digestibility at 48 hours; ME lb, metabolizable energy in pounds; ME kg, metabolizable energy in kilograms; and TDN 1X, total digestible nutrients at one times maintenance level.

[§]N, number of samples; and SD, standard error.