Northern NY Agricultural Development Program
2014 Project Report

Pre- and Post-Harvest Evaluation of Alfalfa-Grass in Mixed Stands for Maximizing Economic Return

Project Leader:
Debbie J. Cherney, Cornell University Department of Animal Sciences,
329 Morrison Hall, Ithaca, NY

Collaborator(s):
. Kitty O'Neil, CCE Regional Field Crops and Soils Specialist, St. Lawrence, Clinton, Essex, and Franklin counties
. Michael Hunter, CCE Field Crops Specialist, Jefferson and Lewis counties
. Cornell University Campus Collaborators: Jerry Cherney and Ken Paddock, Soil and Crop Sciences; Keenan McRobert, Animal Sciences

Cooperating Producers:
. Clinton County: Brian Sipley, Don Tetrault, Miner Institute
. Franklin County: Bob Hazen, John Ray Leinbach, Dave Moore, Randy Ooms, Craig Tucker, Dave Vincent
. Jefferson County: Bill Eastman, Mike Hunter, Mike Kiechle, Lynn Murray, Mike Northrup, Dale Porter, Dan Reed, Doug Shelmidine
. Lewis County: Glen Beller, Ernest Beyer, Bernard Gohlert, Bob Hanno
. St. Lawrence County: William Dalton, Clark Decker, Jon Greenwood

Background:
While the vast majority of alfalfa seedings in NYS and New England are sown with a companion perennial grass, this is not the case in the rest of the northern USA. The Midwest seeds less than 15% of its alfalfa acreage with a companion perennial grass, and almost all alfalfa is pure seedings in the western USA. In addition, with the introduction of Roundup-Ready alfalfa varieties, there will be even less interest in mixed stands in most of the country.

We conducted a survey of alfalfa acreage in NYS during the fall of 2014, with most data provided courtesy of agronomic consultants in the state. Data (185,000 alfalfa acres) was

obtained from 564 farms: 30% Small (<500 acres/farm), 40% Medium, and 30% Large (>1500 acres/farm). Overall across NYS, only 16% of the alfalfa acreage was seeded as pure alfalfa, the rest was seeded with perennial grass. For northern NY only 3% of the alfalfa acreage was seeded as pure alfalfa.

Most of the alfalfa acreage in this survey (68%) was on large farms, and large farms averaged only 15% pure alfalfa for their alfalfa acreage. The largest percentage of alfalfa acreage that was pure alfalfa was found on small farms (22%), the opposite of what was expected. It appears that less than 0.5% of NY alfalfa acreage is currently planted with RR-alfalfa cultivars.

To achieve desired nutrient reductions and increase efficiencies in perennial forage stands, it is essential also to know the alfalfa-grass percentage in a mixed alfalfa-grass stand. Both pre- and post-harvest estimates of alfalfa-grass % are useful, for a number of reasons:

1. Required information, along with alfalfa maximum height, to estimate mixed stand NDF.
2. Help to identify the optimum quality harvest date of mixtures.
3. Allow ranking of fields for harvest, based on alfalfa %.
4. Help to decide when to start treating a stand like grass, from a fertility standpoint.
5. Provide information for deciding when to rotate a field.
6. Assess stand deterioration due to alfalfa insect/disease problems, in particular alfalfa snout beetle damage in northern NY.
7. Some nutrient record keeping software requires input of alfalfa %.
8. Required information for some forage quality software, such as MILK2006, alfalfa-grass version.
9. May help with ration balancing.
10. Quality control: serves as a check on just how representative your forage sampling is. Highly variable alfalfa % over years indicates unrepresentative sampling.

Fiber digestibility declines over one percentage unit per day in spring growth, and spring harvest accounts for about 50% of the total yield used as forage for lactating cows. Each one percentage unit decline in fiber digestibility decreases milk production by 0.5 to 1 lb per cow per day. Accurate prediction equations exist for estimating nutritive value and timing of spring alfalfa-grass harvest. The weak link is estimating the alfalfa fraction in the sward, which is very difficult to estimate by visual observation alone.

Timing of spring forage harvests in northern NY is critical to ensure high quality forage for dairy cattle production. Spring forage quality and timing can be predicted based on NDF concentration. Optimal timing ensures high quality first cutting spring forages, and sets the stage for high quality subsequent harvests throughout the season. There currently is no quick and effective method of estimating alfalfa percentage of a mixture prior to harvest.

An innovative interdisciplinary approach that combines forage science and computer science has been applied to develop a useful user-friendly application to assess mixed-stand composition from digital images and generate optimal timing estimates for spring forage harvests. This system can contribute to improving the sustainability of quality forage production on northern NY dairies by reducing uncertainty in spring forage harvests. It can also improve productivity by reducing purchased forage costs and ultimately increasing dairy farm net incomes.

A method of post-harvest estimation of alfalfa-grass % is by calibrating an NIRS instrument, but commercial labs have shown no interest in doing this until recently. A prediction equation can be developed to predict alfalfa-grass %, but it may require separate prediction equations for fresh forage and silage.

Methods:

For calibrating the pre-harvest evaluation of alfalfa-grass % system, we collected 140 alfalfa-grass samples, after taking cell phone and camera pictures of the sampled area. We hand-separated samples and dried them for determination of actual alfalfa-grass %. Photos were analyzed for alfalfa-grass % using artificial intelligence software.

For developing an NIRS alfalfa-grass % prediction, we collected 45 alfalfa-grass samples, hand-separated them, and dried the samples for combining in known mixtures. Some of the samples were split in half, and half of the alfalfa and grass were ensiled in vacuum bags for 30 days. These samples were then dried for later use in mixtures. Dry samples were coarsely ground, mixed in known proportions, and reground for analysis by NIRS at DairyOne. Samples were mixed in combinations of 0, 20, 40, 60, 80, 100% alfalfa for NIRS calibration, with a total of 540 individual samples analyzed by NIRS. DairyOne labs developed prediction equations for both of their NIRS instruments.

Results:

Pre-Harvest Estimation of Alfalfa-Grass Percentage

Photos of 140 alfalfa-grass stands, from each of five different cameras, were evaluated using an artificial intelligence software program. It was determined that predictions for 2014 samples using the previously developed calibration were somewhat inaccurate, so 2014 samples were combined with previous samples for re-developing the calibration for predicting alfalfa-grass % based on photo evaluation. Both the season and the grass species present have some impact on the ability of the software to accurately estimate alfalfa-grass percentages.

NIRS Alfalfa-Grass Calibration for Post-Harvest Samples

DairyOne calibrated both their older generation 6500 NIRS instrument, as well as their newer generation XDS-1590 NIRS instrument, analyzing all 540 samples with both instruments. Calibrations for grass % worked equally well with both instruments (Table 1). Equally as important, it was determined that one calibration worked just as well for both fresh and ensiled samples, greatly simplifying the process. A set of random validation samples were tested to see how well the calibration equation performed in

predicting grass % (Table 2). All predictions were reasonable estimations of actual grass percentage.

Conclusions/Outcomes/Impacts:

DairyOne Forage Lab will provide NIRS Grass% estimations for any alfalfa-grass forage sample submitted from northern NY in 2015. Farmers can use this information to:

1. Allow ranking of fields for harvest in 2016, based on Grass%.
2. Switch to grass fertility management, if over 50% grass.
3. Assess stand deterioration due to alfalfa snout beetle.
4. Use grass % data in nutrient management software.
5. Over cuts and years, grass % data will indicate whether or not sampling is representative of the field. Grass % in a particular field should follow a consistent pattern over cuts within a year, and should increase over years.

Outreach:

Tool for determining NDF of standing alfalfa-grass mixtures: www.forages.org. Two articles on alfalfa-grass management and feeding have been written for summer 2015 publication in Progressive Forage Grower magazine.

Next steps:

More sample collection and analysis is required to effectively calibrate a cell phone photo + software analysis system to estimate alfalfa-grass percentage in standing forage. A few more additional samples should be collected, separated, and recombined in known mixtures to further test the DairyOne NIRS grass % calibration.

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For More Information:

Debbie J. Cherney
Cornell University Department of Animal Science
327 Morrison Hall
607-255-2882, djc6@cornell.edu

Table 1. NIRS Grass% Calibrations, DairyOne Labs.

Calibration	Instrument	Pop. mean	St. Dev.	SEC	RSQ	SECV	1-VR
%Grass	XDS-1590	49.8	33.9	2.42	0.995	2.55	0.994
%Grass	6500-2729	50.5	34.1	2.25	0.996	2.53	0.995

Table 2. NIRS Validation samples, DairyOne Labs.

Random Validation samples			
	ACTUAL	**PREDICTED**	**PREDICTED**
	%Grass	XDS-1590	6500-2729
	Reference	Analyzed	Analyzed
Sample #	Value	Value	Value
2133134	60	61.3	64.7
2130899	60	52.4	51.7
2130912	80	78.7	78.8
2130924	80	78.2	76.9
2130929	60	58.9	58.2
2130937	100	100.0	100.0
2133176	60	64.7	61.5
2130939	20	21.4	20.4
2133274	80	79.4	83.3
2131199	100	96.6	98.5
2131207	20	23.6	24.5
2131218	0	1.2	4.4
2133307	19.4	20.5	19.9
2131238	40	39.7	43.5
2133329	100	100.0	100.0
2133706	20	18.2	20.3
2133713	40	39.6	38.5
2133722	100	100.0	100.0
2131700	40	33.0	35.6
2132637	0	2.0	2.8
2133755	0	0.0	0.0
2133775	40	37.8	36.9
2133779	0	0.0	0.0
2133807	80	81.3	75.9
AVE.	50.0	49.5	49.8
St. Dev.	34.9	34.4	34.1