



Northern NY Agricultural Development Program 2015-2016 Project Report

Maximizing Both Alfalfa and Grass Quality of Mixtures

Project Leader:

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

Collaborators:

- J.H. Cherney, Cornell University Soil & Crop Sciences Section
- Mike Hunter, Cornell Cooperative Extension Jefferson County/NNY
- Joe Lawrence, Cornell PRO-DAIRY Program
- Ken Paddock, Cornell University Crop & Soil Sciences Section

Cooperating Producers:

- Lewis County: John Nortz.
- Jefferson County: Dan Reed.

Background:

More than 95% of the alfalfa in Northern NY is sown with a perennial grass. As mixed stands increase in grass percentage, the level of management typically declines, resulting in less than optimum forage for lactating dairy cows. Fiber digestibility declines over one percentage unit per day in spring growth, and spring harvest may account for up to half of the total forage yield used as forage for lactating cows. Although forage quality improvement was mostly ignored in the past by forage breeders, releases of new cultivars for both alfalfa and perennial grass have the potential to greatly improve the quality of this forage mixture.

Forage quality of both grass and alfalfa can be improved by variety selection. Two reduced lignin alfalfa varieties are now available, one conventionally developed (*HiGest360*) and another that was genetically modified (*HarvXtra*). There are also other alfalfa varieties with higher quality claims such as Land O'Lakes' *LegenDairy* and *WL356HQ.RR*. However, the persistence and yield of higher quality alfalfa varieties are unknown in Northern NY.

Several new grasses are being developed or are recently released that all have potential for higher grass quality at the normal harvest time for alfalfa-grass mixtures (late bud to early flower alfalfa). A meadow fescue variety was developed by USDA that has significantly higher neutral detergent fiber digestibility (NDFD) than other meadow fescues and tall fescues. Meadow fescue has the added advantage of being more winter hardy than tall fescue.

Sparse-heading orchardgrass developed by USDA in Wisconsin also has been shown to have higher forage quality than conventional orchardgrass. 'DglF47' sparse-heading orchardgrass has not yet been released by Barenbrug Seeds.

Other late maturing varieties of tall fescue ('*Bariane*'), meadow fescue ('*Pradus*'), and orchardgrass ('*Command*', '*Dividend VL*', and '*Barlegro*') are available. '*Dividend-VL*' from Canada, in particular, claims to head up to 2 weeks later than our current latest-heading orchardgrass. Later-maturing grasses will be higher in quality compared to earlier grasses, when alfalfa reaches the appropriate harvest stage. Festuloliums can have high quality, depending on the relative proportions of rye grass and fescue in a given hybrid, but persistence is unknown.

Methods:

We established alfalfa-grass trials on Northern NY farms in Jefferson and Lewis counties in the spring of 2016. While the Lewis County site established satisfactorily, the Jefferson County site had very little grass in mixtures due to severe drought.

The Jefferson County site was mowed off several times in 2016 to control weeds, but was not harvested.

The Lewis County site established satisfactorily in spite of drought. Four alfalfa varieties in mixture with 5 perennial high quality grasses were sown, with 6 field replicates, totaling 120 plots (3' x 20') per site.

Alfalfa: Pioneer 55H94 (normal), *HarvXtra* LL, *Hi-Gest* 360 LL, *LegenDairy XHD*.

Grass: *BarFpF32* meadow fescue (MF), *DglF47* orchardgrass (OG), *Dividend-VL* OG, *Bariane* tall fescue (TF), *Fojtan* Festulolium.

- 55H94 (Pioneer) has been the top-yielding alfalfa in Cornell trials.
- *HarvXtra* (Forage Genetics) and *HiGest 360* (Alforex) are low-lignin types.
- *LegenDairy XHD* (Land O Lakes) was bred for high NDFD.
- *BarFpF32* (Barenbrug) is a high NDFD meadow fescue.
- *DglF47* (Barenbrug) is a sparse-heading high quality orchardgrass.
- *Dividend-VL* (Quality Seeds) orchardgrass is reported to be extremely late heading.
- *Bariane* (Barenbrug) is the latest maturing tall fescue.
- *Fojtan* (DLF) is a high quality cross between ryegrass and tall fescue, and is the festulolium with the best chance of overwintering northern NY winters.

Seeding rate for alfalfa was approximately 15 lbs/acre, with the same number of live seeds per square foot for each alfalfa entry. Grass seeding rates varied from 5 to 6 lbs/acre depending on the grass species.

The Lewis County site was mowed off in late June to remove excessive weed growth. Regrowth was harvested August 4, 2016, and again on Sept. 13, 2016. Weeds were still present at the August 4 cutting, with considerably fewer weeds at the September harvest.

Samples were hand-separated into alfalfa and grass fractions at each harvest, with any weeds discarded. Harvesting required four individuals and multiple vehicles at the site, with refrigerated sample storage to preserve samples for separation and drying in Ithaca. Up to eight individuals were available for the sample separations in Ithaca.

Alfalfa and grass were analyzed separately for CP: crude protein, NDF: neutral detergent fiber, IVTD: in vitro true digestibility, NDFD, and alfalfa was also analyzed for lignin.

With 20 alfalfa-grass combinations and 6 field replicates, two seeding year harvests generated 480 samples for analysis in 2016.

Results:

At the end of 2016, grass percentages (grass%) in Lewis County alfalfa-grass mixtures were:

- Meadow Fescue 20%
- Tall Fescue 15%
- Festulolium 8%
- Orchardgrasses 30% and 33%.

Grass% in established stands is a function of the grass species and the environmental conditions during establishment. The Grass% for the two orchardgrasses in 2016 is too high, likely resulting in very high grass% in these stands in 2017.

A 2016 spring establishment of the same varieties of meadow fescue, festulolium and one of the orchardgrasses in Ithaca under severe drought conditions resulted in grass% at the end of the season of 9% meadow fescue, 2% festulolium and 19% orchardgrass in mixture with alfalfa.

Our 2015 seedings in NY's Wyoming and Oneida counties had excessive festulolium, orchardgrass, and tall fescue (>40%) in mixtures during the first production year in 2016.

The same number of pure live seeds per square foot were seeded for all grasses in current studies. Any new field studies using either ryegrass-type festuloliums or orchardgrass will need to be sown at a considerably lower seeding rate (live seeds/square foot) than other grasses.

Alfalfa cut August 4, 2016, in Lewis County was relatively immature and weedy. Weeds were removed during separations prior to analysis. Alfalfa was high in CP, low in NDF and relatively high in fiber digestibility (NDFD48hr) (Table 1).

Alfalfa varieties were relatively similar in CP and NDF, but were significantly different in NDFD and lignin. The GMO-reduced lignin *HarvXtra* had the highest NDFD in both cuts, but was not significantly different from *Alforex Hi-Gest 360*. As expected, *HarvXtra* was considerably lower in lignin than the other varieties, averaging 10% and 14% lower lignin for the two cuts, compared with the average of the other three entries.

A September seeding-year harvest in Ithaca, comparing *HarvXtra* with *WL355HQ* produced alfalfa that was 7.5% higher NDFD and 17% lower in lignin for *HarvXtra* compared to *WL*. For all five cuts during the first full production year in 2016 in Wyoming and Oneida counties, *HiGest 360* was significantly higher in NDFD and lower in lignin than *Pioneer 55H94*. More data is needed to determine how consistently reduced-lignin alfalfas will result in higher fiber digestibility.

The five grass entries in the Lewis County trial managed to become established in spite of a drought-stressed establishment period. Separated grass was analyzed for both harvests, although seeding-year grass is not very normal compared to production years, because none of the grasses head out in the seeding year. Grass was high in CP and had relatively normal NDF content for both cuts (Table 2).

Fiber digestibility of meadow fescue was consistently and significantly higher than other grasses for both cuts. Meadow fescue was 6% and 5% higher in NDFD than the mean of tall fescue and festulolium for cuts 1 and 2. Meadow fescue was 10% and 12% higher in NDFD than the mean of the orchardgrasses for cuts 1 and 2.

Results from other sites around the state are producing very consistent results for NDFD in meadow fescue. Meadow fescue was 8% higher in NDFD than orchardgrass in a 2016 Ithaca seeding. The only grass that has had similar NDFD to meadow fescue has been a ryegrass-type festulolium (*Perseus*) that was too competitive for alfalfa mixtures. The festulolium in Lewis County (*Fojtan*) is a fescue-type festulolium, which tends to be less competitive, more persistent, and somewhat lower quality than ryegrass-type festuloliums.

Conclusions/Outcomes/Impacts:

Alfalfa-grass trials using improved alfalfa varieties and higher quality grasses show the potential to significantly increase milk production, and possibly increase yields. In first production year yields in Wyoming and Oneida counties in 2016, for every 10% unit increase in grass%, yield in mixed stands increased by 0.4 tons/acre, across a range of 10% to 60% grass in stands.

Any yield increases due to increased grass% in alfalfa stands are probably impacted by general soil fertility levels. That is, the higher the soil fertility, the greater will be any yield increases due to increased grass in a mixed stand.

It appears that switching from orchardgrass to meadow fescue in alfalfa mixtures will increase fiber digestibility of mixtures by as much as a switch from normal alfalfa to a reduced-lignin alfalfa.

Feeding trials across the USA have shown that a one percentage unit increase in NDFD increases milk production by more 1 lb/cow day for high producing dairy cows.

High quality grass grown with high quality alfalfa will result in much higher fiber digestibility of the mixed forage. We also need a consistent proportion of grass in the mixture, without too much grass. Research to-date indicates that an optimum grass% in alfalfa-grass stands may be around 20-30% grass.

Outreach:

This alfalfa-grass research was reported at a number of extension meetings (more than 600 attendees) and conferences during 2016:

- Jan. 6 Oneida County Crop Congress, Waterville, NY
- Jan. 8 Southern Tier Crop Congress, Belfast, NY
- Jan. 25 King's Agriseed Conference, Fort Plain, NY (2 presentations by J.H. Cherney and D.J.R. Cherney)
- Jan. 26 King's Agriseed Conference, Malone, NY (2 presentations)
- Jan. 27 King's Agriseed Conference, Lowville, NY (2 presentations)
- Jan. 28 King's Agriseed Conference, Pavilion, NY (2 presentations)
- Jan. 29 King's Agriseed Conference, Romulus, NY (2 presentations)
- Feb. 3 NNY Crop Congress, Watertown, NY
- Mar. 16 Madison County Crop Congress, Cazenovia, NY
- July 12 Optimizing forage quality of alfalfa-grass mixtures. D.J.R. Cherney, North American Alfalfa Improvement Conference, Madison, WI.
- July 13 Forage quality improvement in reduced-lignin alfalfa monocultures and alfalfa-grass binary mixtures. D.J.R. Cherney, J.H. Cherney, S.R. Smith, C.C. Sheaffer, and M.S. Wells, North American Alfalfa Improvement Conference, Madison, WI.
- July 27 On-farm alfalfa-grass meeting, Curtin Dairy, Oneida County.
- Nov. 2 CCE Inservice meeting, Alfalfa-grass mixtures, J.H. Cherney, Ithaca, NY.
- Nov. 29 CCA Advanced Training. Low-lignin Alfalfa and Grass. J.H. Cherney, Syracuse, NY.

Next Steps:

It is clear there is considerable potential to increase forage quality of both alfalfa and grass in mixtures through species/variety selection, but we need more information on which varietal combinations of alfalfa and grass maximize yield and quality, and will persist under northern NY conditions. Field trials at another northern NY site to compare these alfalfa and grass varieties to evaluate how seeding-year environment affects grass% in mixtures are warranted.

Acknowledgments:

In addition to the Northern New York Agricultural Development Program funding for this research, the NY Farm Viability Institute is funding methods for improving management of alfalfa-grass stands in NY by improving grass% estimation methods, and USDA-NIFA is providing funding for evaluation of GMO reduced-lignin alfalfa in pure and mixed stands for a multi-state project (NY, MN, and KY), allowing us to focus specifically on improving alfalfa-grass production in NY.

Reports and/or articles in which results of this project have been published:

- Extension and research articles based on NNYADP research, 2016.
- J.H. Cherney, D.J.R. Cherney and K.M. Paddock. 2016. Alfalfa-meadow fescue mixtures – something to consider. What’s Cropping Up? Vol. 6, No. 4 p. 55-57.
- J.H. Cherney, D.J.R. Cherney and K.M. Paddock. 2016. Alfalfa-grass mixtures – 2016 Update. What’s Cropping Up? Vol. 26, No. 6 p. 111-113.
- Karayilanli, E., J.H. Cherney, P. Sirois, D. Kubinec, and D.J.R. Cherney. 2016. Prediction of botanical composition of alfalfa-grass mixtures using near infrared reflectance spectroscopy (NIRS): Developing a robust calibration. Crop Science 56:3361-3366.
- K.C. McRoberts, B.M. Benson, E.L. Mudrak, D. Parsons, and D.J.R. Cherney. 2016. Application of local binary patterns in digital images to estimate botanical composition in mixed alfalfa-grass fields. Computers and Electronics in Agriculture, 123:95-103.

For More Information:

- Debbie J.R. Cherney, Department of Animal Science, Cornell University, DJC6@cornell.edu, 607-255-2882, www.forages.org.

Appendix

Table 1. Alfalfa forage quality, Lewis County, August 4 and September 13, 2016, Maximizing Both Alfalfa and Grass Quality of Mixtures project in NNY, 2016.

Alfalfa	CP, %	NDF, %	NDFD, % of NDF	Lignin, %
Cut 1				
P 55H94	23.8	25.0	51.4b	4.04a
HarvXtra	23.5	24.4	55.6a	3.64b
Hi-Gest 360	21.8	25.7	54.7a	4.00a
LegenDairy	22.3	25.5	54.8a	4.03a
	NS	NS	Sig.	Sig.
Cut 2				
P 55H94	25.5	33.3a	44.6c	5.67a
HarvXtra	25.8	31.2c	49.6a	4.72c
Hi-Gest 360	26.6	32.1bc	48.3ab	5.30b
LegenDairy	25.1	32.7ab	46.4bc	5.59a
	NS	Sig.	Sig.	Sig.

Table 2, Grass forage quality, Lewis County, August 4 and September 13, 2016, Maximizing Both Alfalfa and Grass Quality of Mixtures project in NNY, 2016.

Grass	CP, %	NDF, %	NDFD, % of NDF
Cut 1			
BARFpF 32 MF	22.7a	49.3c	87.8a
Bariane TF	22.0ab	47.5d	83.8b
DgLF47 OG	20.8b	52.3b	79.6d
Dividend OG	20.9b	53.4a	80.2cd
Fojtan Festul.	21.0ab	50.3c	81.7c
	Sig.	Sig.	Sig.
Cut 2			
BARFpF 32 MF	24.0b	53.2b	75.7a
Bariane TF	25.5a	52.2c	71.5b
DgLF47 OG	21.2c	56.2a	66.7c
Dividend OG	21.0c	56.2a	68.0c
Fojtan Festul.	26.3a	52.4c	73.3b
	Sig.	Sig.	Sig.