



Northern NY Agricultural Development Program 2016-2017 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, 607-255-2882, djc6@cornell.edu

Collaborator(s):

- J.H. Cherney, Soil & Crop Sciences, Cornell University
- Mike Hunter, Cornell Cooperative Extension, Jefferson/Lewis Counties
- Joe Lawrence, Cornell PRO-DAIRY

Cooperating Producers:

- Lewis County: John Nortz
- Jefferson County: Dan Reed, Reed Haven Farms
- Jefferson County: Lynn Murray, Murcrest Farm

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 breeders, there are releases of new cultivars for both alfalfa and perennial grass that 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. Three reduced-lignin alfalfa varieties are now available: two conventionally-developed (Hi-Gest 360, and KF 425HD) and another that was genetically modified (HarvXtra). There are also numerous other alfalfa varieties with higher quality claims. Persistence and yield of higher quality alfalfa varieties are currently unknown in Northern NY.

Several new grasses are being developed or have been 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 NDFD than other meadow fescues and tall fescues. Meadow fescue has the added advantage of being more winter hardy than tall fescue.

This research evaluates several variety options for their potential to enhance alfalfa-grass production by Northern New York growers.

Methods:

We established alfalfa-grass trials at the Reed and Nortz farms respectively in Jefferson and Lewis counties in the spring of 2016 (See Maximizing Both Alfalfa and Grass Quality of Mixtures 2016 NNYADP project report at www.nnyagdev.org). 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 as follows:

Alfalfa:

- Pioneer 55H94 (normal): top-yielding alfalfa in Cornell trials
- HarvXtra (Forage Genetics): low-lignin
- Hi-Gest 360 (Alforex): low-lignin
- LegenDairy XHD (Land O Lakes): bred for high NDFD

Grass:

- BarFpF32 meadow fescue (MF) (Barenbrug): high NDFD meadow fescue
- DflF47 orchardgrass (OG) (Barenbrug): sparse-heading, high quality orchardgrass
- Dividend-VL OG (Quality Seeds): reported to be extremely late heading
- Bariance tall fescue (TF) (Barenbrug): latest maturing tall fescue
- Fojtan Festulolium (DLF): high quality ryegrass-tall fescue cross, the festulolium with the best chance overwintering Northern NY winters.

On May 17, 2017, we planted a trial at Murcrest Farms in Jefferson County with three low-lignin alfalfas:

- HarvXtra, Hi-Gest360, and KF425HD sown in mixture with seven grasses: Bariance TF, Tetrax, Pradel and Preval MF, Dividend VL OG, Chiefton reed canarygrass, and Sunset III timothy.

The trials seeded in 2016 were harvested three times in 2017; the new seeding at Murcrest Farms was harvested twice in 2017. The Murcrest plots were mowed off once to control weeds before the first 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, NY. Up to eight individuals were available for the sample separations in Ithaca.

Alfalfa and grass were analyzed separately for crude protein (CP), neutral detergent fiber (NDF), invitro true digestibility (IVTD), neutral detergent fiber digestibility (NDFD), Acid Detergent Fiber (ADF), and lignin. Lignin was not analyzed for Jefferson County (Reed) samples. With 120 plots harvested three times for both 2016 seedings, and 126 plots harvested twice at Murcrest, this generated a total of 1944 forage samples for analysis in 2017.

Results:

Yield

Three-cut yields averaged 4.7 tons/a for the Nortz farm site and 4.1 tons/acre for the Reed farm site (Table 1). Grass growth was strongly encouraged by above average rainfall early in the season. This resulted in a large proportion of grass in mixtures at all three farm sites (Tables 2 & 3).

While the grass proportion in a mixture can impact yield and the CP content of grass, it does not significantly impact all other forage quality measurements for both alfalfa and grass. Festulolium had the lowest grass percentage in mixtures for both sites, while orchardgrass was consistently highest in grass percentage of mixtures.

The new seeding at Murcrest Farms is located on a very fertile site. Above normal rainfall after seeding on this fertile site resulted in excessive grass growth that strongly competed with alfalfa. In other years, our alfalfa-grass seedings were typically 5-10% meadow fescue at the end of the seeding year; in 2017; the new seeding at Murcrest exceeded 50% meadow fescue.

Alfalfa Quality

HarvXtra alfalfa was consistently higher in fiber digestibility (NDFD) when compared to the mean of other alfalfas, averaging over harvests from 4 to 7% higher. However, HarvXtra did not differ significantly from Hi-Gest 360 at second and third cuts for both Nortz and Reed sites. For all of our alfalfa-grass studies across New York State (NYS) in 2017, HarvXtra averaged 5.3% higher in NDFD than other alfalfas.

HarvXtra is always significantly lower in lignin than other alfalfa varieties, averaging 14% lower lignin across all our NY studies in 2017. HarvXtra averaged 13% lower lignin and 7% higher NDFD than the two conventionally-bred reduced-lignin varieties (Hi-Gest and KF425HD) at Murcrest. Alfalfa was relatively immature at both Murcrest harvests, as noted by the very low NDF values.

Pioneer 55H94 was consistently higher in fiber content compared to the other alfalfa varieties. Varieties were similar in CP content at both sites, but the Lewis County alfalfa in general was considerably higher in CP.

Grass Quality

Meadow fescue was consistently higher in fiber digestibility than other grasses in the 2017 trial (Tables 2 & 3). Across all of our alfalfa-grass studies in NYS, meadow fescue averaged 17% lower lignin and 9.7% higher NDFD than other grasses. At two sites in

NY where the tetraploid Tetrax MF was compared to other meadow fescues, it was significantly higher in NDFD.

Sparse-heading orchardgrass is typically significantly higher quality than normal orchardgrass, as at the Nortz and Reed farm sites, but it is still well below the quality of meadow fescue. The weather favorable to grass resulted in somewhat abnormal quality at harvest. In Lewis County, average grass NDF over the season was in the upper 50s, while average alfalfa NDF was in the low 30s. Orchardgrass was low in CP compared to other grasses, particularly at the Reed site.

Grass Quality of New Seeding

While it is reasonable to compare alfalfa varieties for quality in a seeding year, this is not so clear with grasses. Grasses do not head out in the seeding year, and quality changes that vary with heading date are not present in the seeding year. A quality “outlier” for grasses is timothy in the new seeding at Murcrest. It was as high in NDFD as Tetrax MF, but only because it was extremely short and immature. The timothy mixture was the lowest yielding alfalfa-grass mixture. Grass quality comparisons in a seeding year are useful only for that seeding year; they are not indicative of what will happen in a full production year.

Conclusions/Outcomes/Impacts:

Crude protein content in all the 2017 alfalfa-grass mixtures, except possibly for alfalfa-OG at the Reed site, was adequate.

The combination of reduced-lignin alfalfa with meadow fescue can result in a large increase in forage NDFD.

On average in 2017, it appears that including HarvXtra and meadow fescue in a mixture would increase forage NDFD by 6%, assuming a mixture that is 30% grass. In a 30% grass mixture, the addition of meadow fescue increases NDFD of the mixture by the same amount as adding HarvXtra to the mixture.

While essentially every seed company is promoting alfalfa varieties claiming higher quality, it is clear that switching to meadow fescue in mixtures may have more impact on forage quality than switching to most of the high quality alfalfa varieties available.

Outreach:

This alfalfa-grass research was reported at a number of extension meetings and conferences in NY during 2017, with over 500 attendees.

- Jan. 4 Oneida County Crop Congress
- Feb. 16 Broome County Crop Meeting
- Feb. 21 Western NY Crop Management Meeting
- Feb. 28 Western NY Forage Congress
- Mar. 1 Delaware County Crop School
- Mar. 7 Steuben County Crop Symposium
- Sep. 30 National Hay Association Conference, Canandaigua, NY

Next Steps:

Clearly, meadow fescue has great potential in mixture with alfalfa, and the combination of meadow fescue and high quality alfalfa should lead to significantly improved forage quality. We will harvest the Murcrest Farms site in 2018 to evaluate the quality of the 7 grasses and 3 alfalfas in a full production year. The main issue at this point is getting a 20-30% grass mixture. To clarify this issue, in 2018 we will evaluate meadow fescues at several seeding rates with alfalfa, and will include the new tetraploid meadow fescue variety, which looked very promising in 2017.

Acknowledgments:

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). We have also received funding from the National Alfalfa & Forage Alliance (alfalfa seed checkoff funds) to evaluate forage quality of a wide range of alfalfa varieties in Ithaca. These funding sources plus NNYADP grant funds are 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:

- Cherney, J.H., D.J.R. Cherney, and K.M. Paddock. Alfalfa-Grass Mixtures – 2016 Update. What's Cropping Up? Vol. 26, No. 6, Jan. 2017.
- Cherney, J.H., and D.J.R. Cherney. Reduced-lignin Alfalfa – A Current Assessment. May 2017 Progressive Forage magazine.
- Jaynes, L., Can Research Verify Alfalfa Claims? Oct. 2017. Progressive Forage magazine.
- Rankin, M. Finding an Alfalfa Dance Partner. Nov. 2017. Hay & Forage Grower magazine.
- Cherney, J.H., D.J.R. Cherney, and K.M. Paddock. Alfalfa-Grass Mixtures – 2017 Update. The Manager section of Progressive Forage magazine.
- Casler M.D., G.E. Brink, and J.H. Cherney. 2017. Registration of 'Azov' Meadow Fescue. J. Plant Registrations 11:9-14.

For More Information:

Debbie J.R. Cherney, Department of Animal Science, Cornell University;
djc6@cornell.edu; 607-255-2882,: www.forages.org.

Table 1. First production year, 2017, average of 3 harvests, alfalfa; Alfalfa-Grass Mix Quality Project, NNYADP, seeded in 2016.

	P55H94	HarvXtra	Hi-Gest	LegenDairy
Lewis County (Nortz)				
Yield, tons/a	4.68 a	4.70 a	4.58 a	4.89 a
NDF, %DM	33.7 a	32.4 b	32.5 b	33.7 a
ADF, %DM	27.0 a	25.3 b	25.6 b	26.4 a
Lignin, %DM	5.95 a	5.27 b	5.82 a	6.00 a
IVTD, %DM	84.0 c	86.0 a	85.0 b	84.2 c
NDFD, % NDF	58.4 b	62.0 a	59.6 b	59.2 b
CP, %DM	24.9 a	25.4 a	25.6 a	26.4 a
Jefferson County (Reed)				
Yield, tons/a	4.40 a	3.85 b	4.02 b	4.15 ab
NDF, %DM	36.7 a	33.6 c	35.0 b	35.4 b
ADF, %DM	29.7 a	26.3 c	27.8 b	28.3 b
Lignin, %DM	6.10 a	4.93 c	5.83 b	5.91 ab
IVTD, %DM	80.6 c	83.8 a	82.3 b	82.0 b
NDFD, % NDF	47.3 c	52.2 a	49.8 b	49.6 b
CP, %DM	22.1 a	21.8 a	21.7 a	21.6 a

Means on the same line with the same letters are not different.

Quality means are a weighted (by yield) average of 3 cuts.

Table 2. First production year, 2017, average of 3 harvests, grass; Alfalfa-Grass Mix Quality Project, NNYADP, seeded in 2016.

	MF	TF	OG 1	OG 2	Festul.
Lewis County (Nortz)					
Yield, tons/a	4.50 bc	4.49 bc	4.75 b	5.47 a	4.35 c
Grass, %	63.2 b	56.2 c	79.3 a	83.2 a	54.0 c
NDF, %DM	56.4 c	53.5 e	57.9 b	60.0 a	55.3 d
ADF, %DM	33.4 c	30.8 e	34.7 b	36.2 a	32.2 d
Lignin, %DM	2.66 d	2.77 d	3.55 b	3.76 a	3.00 c
IVTD, %DM	86.9 a	85.1 b	82.5 c	80.7 d	83.9 b
NDFD, % NDF	69.6 a	66.4 bc	65.3 cd	62.8 e	64.7 d
CP, %DM	18.9 b	20.7 ab	17.0 c	16.0 c	20.1 a
Jefferson County (Reed)					
Yield, tons/a	4.03 b	3.96 b	4.11 ab	4.40 a	4.04 b
Grass, %	60.1 b	50.1 c	71.4 a	77.5 a	45.8 c
NDF, %DM	60.4 b	57.2 d	60.9 b	62.6 a	58.7 c
IVTD, %DM	83.7 a	82.0 b	80.8 c	78.4 e	79.6 d
NDFD, % NDF	73.8 a	68.9 b	68.7 b	66.0 c	65.6 c
CP, %DM	14.6 b	15.6 a	13.6 c	12.1 d	16.0 a

Means on the same line with the same letters are not different.

Quality means are a weighted (by yield) average of 3 cuts.

OG 1 = sparse-heading orchardgrass, OG 2 = normal orchardgrass.

Table 3. Seeding year yield and quality, 2 harvests; Alfalfa-Grass Mix Quality Project, NNYADP, 2017.

	Alfalfa			Grass						
	HarvXtra	Hi-Gest	KF425HD	TF	RC	OG	Tim	PreMF	PraMF	TetMF
Yield, tons/a	2.29 a	2.31 a	2.40 a	2.55 a	2.25 b	2.30 b	1.99 c	2.50 a	2.47 a	2.29 b
NDF, %DM	28.8 b	29.4 ab	29.8 a	49.1 bcd	59.0 a	46.8 d	48.2 bcd	55.8 abc	61.1 a	42.2 d
ADF, %DM	23.4 b	24.8 a	25.2 a	50.4 b	53.8 a	54.2 a	50.9 b	50.4 b	51.4 b	45.3 c
Lignin, %DM	4.49 b	5.09 a	5.21 a	89.2 c	83.4 e	86.9 d	92.2 a	90.8 b	90.6 b	93.1 a
IVTD, %DM	87.7 a	86.3 b	85.9 b	78.8 c	69.5 e	75.9 d	84.7 a	81.8 b	81.7 b	84.9 a
NDFD, % NDF	58.0 a	54.4 b	53.8 b	25.2 ab	25.0 ab	21.6 c	22.9 bc	24.2 b	23.0 bc	26.8 a
CP, %DM	27.4 a	28.6 a	27.4 a							

Means on the same line with the same letters are not different.

Quality means are a weighted (by yield) average of 2 cuts.

Preval, Pradel, and Tetrax meadow fescue.