# Yield & Forage Nutritive Value of Reduced Lignin Alfalfa

*Amanda Grev, Scott Wells, Krishona Martinson, Craig Sheaffer, University of Minnesota; Deb Samac, USDA-ARS*

Alfalfa is widely used as livestock forage due to its high nutrient content. However, digestibility and utilization are hampered by its lignin content. Lignin is a complex structural polymer making up part of the fibrous portion of plants. While it provides strength and rigidity for a plant to stand upright, lignin is indigestible and reduces forage fiber digestibility. In recent years, researchers have developed alfalfa varieties with reduced lignin concentrations which have potential to enhance alfalfa feeding value through increased forage digestibility. Improvements in forage nutritive value may lengthen the time period when alfalfa has a nutritive value suitable for high-producing livestock. This allows for a wider optimal harvest window, while achieving greater yields and maintaining acceptable nutritive values.

A recent University of Minnesota (UM) study evaluated yield and forage nutritive value of reduced lignin and reference alfalfa varieties when subjected to diverse cutting treatments during establishment and first production year. Research was completed at the UM Agricultural Experiment Stations at St. Paul, Becker, and Rosemount during the 2015 and 2016 growing seasons. All sites were planted the last week of April, 2015. Treatments included four cuttings with varying harvest frequencies from 30- 45 days. Reference alfalfa varieties were 54R02, DKA43-22RR, and WL 355.RR. The reduced lignin variety was 54HVX41. Prior to harvest, hand samples were taken to determine plant maturity and forage nutritive value. Yields were determined by mechanically harvesting plots using a flail harvester.

Results are presented for the first production year (2016). Across locations, cumulative forage yields ranged 6.6-9.8 tons/ac (Figures 1A-B). Among alfalfa varieties, yields for 54HVX41 were decreased compared to reference varieties at Becker; no differences in yield were present at Rosemount or St. Paul. Yields were greater with a 40-day cutting treatment compared to a 30-day treatment.

All varieties contained ≥18% crude protein (CP), ≤46% neutral detergent fiber (NDF), ≤9% acid detergent lignin (ADL), and ≥28% neutral detergent fiber digestibility (NDFD) (Table 1). Compared to reference varieties, 54HVX41 had similar CP and NDF, reduced ADL, and increased NDFD. On average, 54HVX41 had an 8% reduction in ADL and a 10% increase in NDFD. Shorter harvest interval treatments generally

**Figure 1A.** Cumulative forage yield by alfalfa variety during the first production year (2016) for alfalfa grown in Becker, Rosemount, and St. Paul, MN.

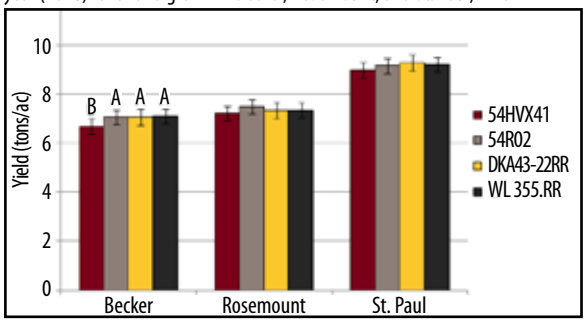
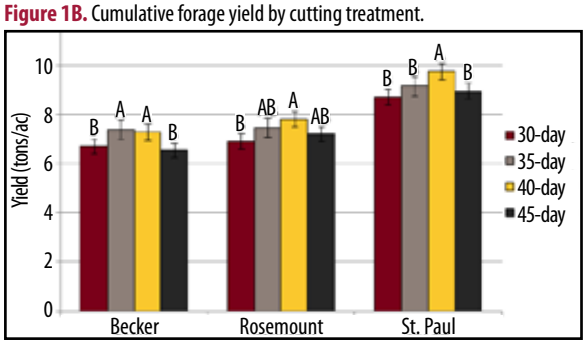



**Figure 1B.** Cumulative forage yield by cutting treatment.




[a-b]Within location, means without a common letter differ ($P \leq 0.05$).

**Table 1.** Forage nutritive values for reduced lignin and reference alfalfa varieties grown in Becker, Rosemount, and St. Paul, MN, during the first production year (2016).

| Variety | Becker | Rosemount | St. Paul |
|---|---|---|---|
| | ----------%DM---------- | | |
| **CP** | | | |
| 54HVX41 | 18.7[a] | 18.6 | 18.2 |
| 54R02 | 18.0[ab] | 18.2 | 17.8 |
| DKA43-22RR | 17.9[ab] | 18.6 | 17.5 |
| WL 355.RR | 17.8[b] | 18.4 | 17.8 |
| SE | 0.24 | 0.34 | 0.25 |
| **NDF** | | | |
| 54HVX41 | 44.1[b] | 40.3 | 41.6 |
| 54R02 | 45.6[ab] | 41.4 | 42.4 |
| DKA43-22RR | 45.8[a] | 40.5 | 43.0 |
| WL 355.RR | 45.2[ab] | 40.7 | 41.9 |
| SE | 0.44 | 0.68 | 0.57 |
| **ADL** | | | |
| 54HVX41 | 8.1[b] | 7.9[b] | 7.7[b] |
| 54R02 | 8.7[a] | 8.5[a] | 8.1[a] |
| DKA43-22RR | 8.8[a] | 8.4[a] | 8.3[a] |
| WL 355.RR | 8.8[a] | 8.5[a] | 8.2[a] |
| SE | 0.08 | 0.14 | 0.12 |
| **NDFD** | | | |
| 54HVX41 | 33.3[a] | 33.3 | 33.9[a] |
| 54R02 | 28.8[b] | 30.0 | 30.6[b] |
| DKA43-22RR | 28.2[b] | 30.5 | 30.5[b] |
| WL 355.RR | 27.8[b] | 30.1 | 30.6[b] |
| SE | 0.69 | 1.05 | 0.81 |

[a-b]Within column and section, means without a common letter differ ($P \leq 0.05$). Standard Error (SE)

**Table 2.** Forage nutritive values for alfalfa grown in Becker, Rosemount, and St. Paul, MN, under various cutting treatments during the first production year (2016).

| Cutting Treatment | Becker | Rosemount | St. Paul |
|---|---|---|---|
| | ----------% DM---------- | | |
| **CP** | | | |
| 30-day | 21.5[a] | 22.1[a] | 21.5[a] |
| 35-day | 18.8[b] | 19.9[b] | 18.7[b] |
| 40-day | 16.3[c] | 16.1[c] | 15.7[c] |
| 45-day | 16.0[c] | 15.8[c] | 15.3[c] |
| SE | 0.24 | 0.34 | 0.27 |
| **NDF** | | | |
| 30-day | 39.1[d] | 34.3[d] | 36.6[c] |
| 35-day | 42.6[c] | 36.8[c] | 40.8[b] |
| 40-day | 48.3[b] | 44.4[b] | 44.6[a] |
| 45-day | 50.7[a] | 47.3[a] | 46.9[a] |
| SE | 0.44 | 0.68 | 0.65 |
| **ADL** | | | |
| 30-day | 7.9[b] | 7.6[b] | 7.5[b] |
| 35-day | 8.2[b] | 7.3[b] | 7.7[b] |
| 40-day | 9.2[a] | 9.0[a] | 8.3[a] |
| 45-day | 9.3[a] | 9.4[a] | 8.7[a] |
| SE | 0.08 | 0.14 | 0.15 |
| **NDFD** | | | |
| 30-day | 36.2[a] | 38.9[a] | 37.3[a] |
| 35-day | 32.2[b] | 36.7[a] | 34.7[b] |
| 40-day | 25.7[c] | 24.2[b] | 26.2[c] |
| 45-day | 24.1[c] | 24.1[b] | 27.5[c] |
| SE | 0.69 | 1.04 | 0.81 |

[a-b]Within column and section, means without a common letter differ ($P \leq 0.05$). Standard Error (SE)

resulted in higher forage nutritive values, including increased CP, decreased NDF and ADL, and increased NDFD (Table 2).

When yields and relative forage quality (RFQ) were regressed across growing degree days (GDD) in the first production year, yields for 54HVX41 and reference varieties were similar (Figure 2A), but RFQ for 54HVX41 was greater compared to reference varieties from 772-1,248 GDD (Figure 2B). This increase in RFQ for 54HVX41 across a wide range of GDD can offer increased flexibility for farmers. Farmers could choose to harvest 54HVX41 at the same time as reference varieties to obtain a more digestible forage product. Or, they could harvest 54HVX41 under a delayed cutting schedule and maintain forage digestibility across a lengthened harvest window. For example, with a 5-day harvest delay, 54HVX41 harvested on a 35-day interval showed a 21% gain in yield and a 3% reduction in RFQ compared to reference varieties harvested on a 30-day interval (Figures 2A-B). This could allow for a wider optimal harvest window, making it possible for farmers to achieve higher yields by delaying harvest while maintaining higher forage nutritive value.

**Figure 2A.** Predicted alfalfa forage DM yield for reduced lignin (54HVX41; *y1*) and reference alfalfa varieties (*y2*) in response to average cumulative GDD.

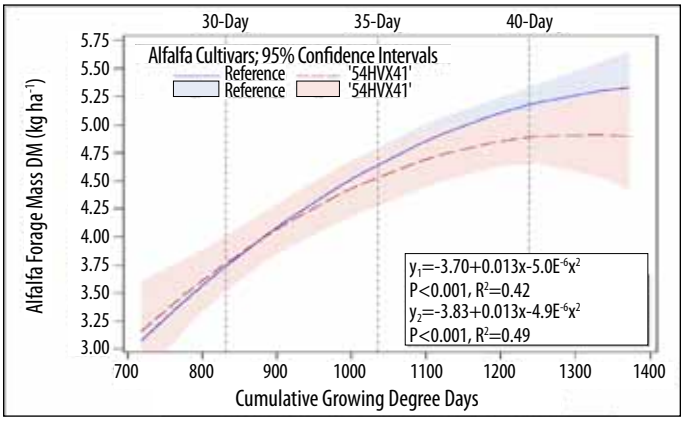



**Figure 2B.** Predicted alfalfa RFQ for reduced lignin (54HVX41; *y1*) and reference alfalfa varieties (*y2*) in response to average cumulative GDD.