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Forage Quality in Vermont - 2006

Sid Bosworth
Extension Agronomist

The following tables summarize the forage quality values from samples tested at the University of Vermont Agricultural Testing Lab submitted in the fall of 2006. Tables are arranged by forage type (grass, legume and mixed haylage and grass hay). There were not enough samples to summarize legume or legume/grass mixed hay. Data was only analyzed from samples that had been specifically identified by cutting and harvested in 2006.

Table 1. The average forage quality values of **grass haylage** samples tested at the University of Vermont Agricultural Testing Lab from October through December of 2006 and grouped by cutting.

Measurement	unit	1st Harvest			2nd Harvest			3rd and 4th Harvest		
		Mean	Range of Values*		Mean	Range of Values*		Mean	Range of Values*	
Dry Matter	% of total	41	28	- 54	44	31	- 57	40	28	- 52
Crude Protein	% of dm	10.9	8.4	- 13.4	14.5	12.5	- 16.4	16.9	14.4	- 19.3
ADICP	% of dm	1.14	0.68	- 1.59	0.99	0.64	- 1.34	0.88	0.54	- 1.22
Available CP	% of dm	10.7	8.1	- 13.2	14.3	12.4	- 16.3	16.8	14.3	- 19.3
Soluble CP	% of dm	40	26	- 55	40	29	- 52	43	33	- 53
ADF	% of dm	42	39	- 46	36	33	- 39	32	27	- 36
NDF	% of dm	66	61	- 72	56	53	- 60	51	45	- 57
Fat	% of dm	3.2	2.6	- 3.8	4.0	3.6	- 4.4	4.2	3.8	- 4.6
Ash	% of dm	8.0	6.9	- 9.2	9.2	8.3	- 10.1	9.8	8.8	- 10.8
Lignin	% of dm	7.0	4.9	- 9.1	6.5	4.6	- 8.3	5.7	3.6	- 7.9
NEL	Mcal/lb.	0.45	0.39	- 0.51	0.55	0.51	- 0.60	0.61	0.54	- 0.68
TDN	% of dm	59	56	- 62	64	62	- 67	67	64	- 71
NFC	% of dm	15.6	11.7	- 19.6	21.2	17.4	- 24.9	23.7	19.0	- 28.4
RFV	none	80	69	- 90	102	92	- 111	119	101	- 138
NDICP	% of dm	3.87	2.88	- 4.87	5.25	4.04	- 6.45	5.50	4.18	- 6.82
Lignin	% of NDF	10.6	7.5	- 13.7	11.4	8.4	- 14.5	11.3	7.2	- 15.4
ADICP	% of CP	11.3	5.5	- 17.1	6.9	4.2	- 9.7	5.5	2.5	- 8.6
NDICP	% of CP	38	24	- 52	37	27	- 47	33	23	- 44
Sugar	% of dm	5.3	4.2	- 6.4	5.8	4.6	- 6.9	6.1	4.8	- 7.4
Starch	% of dm	8.5	6.2	- 10.8	6.6	4.7	- 8.4	5.9	3.7	- 8.1
NSC	% of dm	13.8	10.7	- 16.9	12.3	9.6	- 15.0	12.0	8.8	- 15.2
Calcium	% of dm	0.60	0.45	- 0.76	0.81	0.69	- 0.93	0.93	0.80	- 1.06
Phosphorus	% of dm	0.28	0.23	- 0.33	0.31	0.28	- 0.35	0.34	0.29	- 0.38
Potassium	% of dm	2.0	1.5	- 2.6	2.2	1.7	- 2.6	2.4	1.9	- 2.9
Magnesium	% of dm	0.26	0.23	- 0.29	0.30	0.27	- 0.32	0.31	0.29	- 0.34
Sulfur	% of dm	0.26	0.23	- 0.29	0.32	0.29	- 0.34	0.34	0.31	- 0.37
No. of Samples		296			173			97		

*Equals 1.0 standard deviation which represents about 2/3's of the total samples that are distributed around the mean

Neutral detergent fiber (NDF), which is a measure of the total cell wall content of the forage, is a good indicator of the maturity of the crop at time of cutting. The higher the NDF, the more mature the plant is at cutting. Generally, as NDF increases, crude protein (CP) and energy as measured by net energy of lactation (NEL) or total digestible nutrients (TDN) decreases.

Legumes (Table 2) and legume/grass mixtures (Table 3) had slightly higher crude protein and NEL as compared to grass haylage (Table 1), but time of cut (as assessed by NDF levels) had a greater impact on CP than forage type.

Table 2. The average forage quality values of **legume haylage** samples tested at the University of Vermont Agricultural Testing Lab from October through December of 2006 and grouped by cutting.

Measurement	unit	1st Harvest				2nd Harvest				3rd and 4th Harvest			
		Mean	Range of Values*			Mean	Range of Values*			Mean	Range of Values*		
Dry Matter	% of total	40	28	-	53	37	30	-	45	35	28	-	42
Crude Protein	% of dm	17.3	15.3	-	19.3	19.1	17.8	-	20.3	20.6	18.3	-	22.9
ADICP	% of dm	1.6	1.1	-	2.0	1.4	1.0	-	1.7	1.1	0.9	-	1.4
Available CP	% of dm	16.7	14.6	-	18.9	18.7	17.3	-	20.1	20.4	18.1	-	22.7
Soluble CP	% of dm	49	41	-	58	51	45	-	57	46	33	-	59
ADF	% of dm	41	37	-	45	38	35	-	41	33	29	-	37
NDF	% of dm	52	47	-	56	48	45	-	51	43	40	-	47
Fat	% of dm	2.8	2.2	-	3.3	3.3	3.0	-	3.6	3.8	3.3	-	4.3
Ash	% of dm	9.4	8.7	-	10.2	10.2	9.5	-	10.8	10.3	8.9	-	11.7
Lignin	% of dm	8.8	6.8	-	10.9	8.0	6.3	-	9.6	7.6	6.1	-	9.1
NEL	Mcal/lb.	0.54	0.49	-	0.59	0.58	0.54	-	0.62	0.64	0.59	-	0.68
TDN	% of dm	59	56	-	61	60	58	-	63	64	61	-	66
NFC	% of dm	23	20	-	27	24	21	-	27	27	22	-	33
RFV	none	104	89	-	120	115	103	-	126	137	120	-	154
NDICP	% of dm	4.59	3.59	-	5.59	4.60	3.70	-	5.50	5.40	3.88	-	6.92
Lignin	% of NDF	17.1	13.7	-	20.5	16.6	12.9	-	20.2	17.6	14.1	-	21.2
ADICP	% of CP	9.3	6.2	-	12.5	7.2	5.2	-	9.2	5.7	4.1	-	7.2
NDICP	% of CP	27	21	-	33	24	19	-	29	27	17	-	38
Sugar	% of dm	4.6	3.5	-	5.7	4.7	3.8	-	5.7	5.1	3.0	-	7.2
Starch	% of dm	4.2	2.3	-	6.1	3.6	1.7	-	5.6	3.2	1.5	-	4.9
NSC	% of dm	8.8	6.1	-	11.6	8.3	5.5	-	11.1	8.2	4.8	-	11.7
Calcium	% of dm	1.24	1.09	-	1.38	1.28	1.19	-	1.38	1.34	1.23	-	1.44
Phosphorus	% of dm	0.28	0.24	-	0.32	0.31	0.27	-	0.34	0.34	0.29	-	0.39
Potassium	% of dm	2.4	2.0	-	2.8	2.6	2.2	-	2.9	2.6	1.9	-	3.4
Magnesium	% of dm	0.29	0.27	-	0.32	0.31	0.29	-	0.34	0.33	0.30	-	0.35
Sulfur	% of dm	0.31	0.29	-	0.34	0.34	0.32	-	0.36	0.35	0.31	-	0.39
No. of Samples		19				31				24			

*Equals 1.0 standard deviation which represents about 2/3's of the total samples that are distributed around the mean

Generally, the best haylage quality in terms of higher crude protein, higher energy (NE_L) and lower fiber (ADF and NDF) was made in the 3rd and 4th harvests (Tables 1, 2, and 3). A large majority of the forage samples representing the first harvest were below what would be considered “ideal” for lactating milk cows. For example the average NDF levels for the first harvest of legume silage (Table 2) was 52%, which is about 10 units greater than the 40% recommended for alfalfa. Grasses should be harvested when NDF reaches 50 to 55% NDF¹ and the average NDF for first cut (Table 1) was 66%.

Table 3. The average forage quality values of **legume/grass mixed haylage** samples tested at the University of Vermont Agricultural Testing Lab from October through December of 2006 and grouped by cutting.

Measurement	unit	1st Harvest				2nd Harvest				3rd and 4th Harvest			
		Mean	Range of Values*			Mean	Range of Values*			Mean	Range of Values*		
Dry Matter	% of total	38	27	-	49	39	28	-	49	36	28	-	44
Crude Protein	% of dm	15.1	12.7	-	17.4	17.0	15.2	-	18.8	18.7	16.9	-	20.4
ADICP	% of dm	1.57	1.22	-	1.92	1.38	1.03	-	1.73	1.12	0.82	-	1.41
Available CP	% of dm	14.5	12.1	-	16.9	16.6	14.7	-	18.6	18.5	16.7	-	20.2
Soluble CP	% of dm	47	38	-	55	45	35	-	55	48	41	-	55
ADF	% of dm	42	37	-	46	37	33	-	41	33	29	-	37
NDF	% of dm	57	52	-	62	52	48	-	56	48	44	-	51
Fat	% of dm	3.1	2.5	-	3.7	3.7	3.2	-	4.3	4.0	3.6	-	4.4
Ash	% of dm	9.2	8.2	-	10.2	9.8	8.9	-	10.6	10.4	9.7	-	11.1
Lignin	% of dm	7.8	5.8	-	9.9	7.4	5.5	-	9.3	7.0	5.3	-	8.7
NEL	Mcal/lb.	0.50	0.44	-	0.56	0.56	0.51	-	0.61	0.61	0.56	-	0.66
TDN	% of dm	59	56	-	62	62	59	-	65	65	62	-	67
NFC	% of dm	19.9	15.9	-	23.9	22.8	18.6	-	26.9	24.4	20.7	-	28.1
RFV	none	93	79	-	107	109	94	-	124	124	109	-	139
NDICP	% of dm	4.54	3.63	-	5.45	5.26	4.10	-	6.41	5.21	4.15	-	6.27
Lignin	% of NDF	13.7	10.3	-	17.0	14.2	10.7	-	17.7	14.7	11.1	-	18.3
ADICP	% of CP	10.8	7.5	-	14.2	8.3	5.6	-	11.0	6.0	4.3	-	7.8
NDICP	% of CP	30.8	23.2	-	38.3	31.3	23.5	-	39.1	28.1	22.3	-	33.9
Sugar	% of dm	4.9	3.8	-	6.0	5.2	4.0	-	6.4	5.2	4.1	-	6.3
Starch	% of dm	6.0	4.1	-	8.0	4.8	2.9	-	6.7	4.3	2.2	-	6.5
NSC	% of dm	10.9	8.2	-	13.7	10.0	7.3	-	12.7	9.5	6.5	-	12.5
Calcium	% of dm	1.02	0.88	-	1.16	1.11	1.00	-	1.21	1.15	1.04	-	1.26
Phosphorus	% of dm	0.28	0.24	-	0.33	0.31	0.27	-	0.35	0.33	0.30	-	0.37
Potassium	% of dm	2.3	1.9	-	2.7	2.4	2.1	-	2.8	2.5	2.2	-	2.9
Magnesium	% of dm	0.28	0.26	-	0.31	0.31	0.28	-	0.34	0.33	0.30	-	0.35
Sulfur	% of dm	0.24	0.20	-	0.27	0.26	0.24	-	0.29	0.29	0.27	-	0.31
No. of Samples		47				64				46			

*Equals 1.0 standard deviation which represents about 2/3's of the total samples that are distributed around the mean

¹ Bosworth, Sid, Felix Jimenez and John Aleong. 2004. Predicting Quality of the First Harvest of Cool Season Grasses and Grass/Alfalfa Mixtures Grown for Hay and Silage. In The Vermont Crops and Soils Home Page, Plant and Soil Sci. Dept., Un. of Vermont (<http://pss.uvm.edu/vtcrops/?Page=research/PredictingQualityFirstHarvest.html>).

Grass hay (Table 4), was generally lower in quality than haylage (Table 1), especially for the first harvest. Due to excessive rain in June, there were very few consecutive days of decent drying conditions conducive for hay. As a result, hay was delayed by one to two weeks as compared to most years. Even the better quality hay from the first harvest is less than ideal for lactating dairy cows with NDF levels still being over 60%. It was mostly 3rd and 4th cut and some 2nd cut samples that were of higher quality.

Table 4. The average forage quality values of **grass hay** samples tested at the University of Vermont Agricultural Testing Lab from October through December of 2006 and grouped by cutting.

Measurement	unit	1st Harvest			2nd Harvest			3rd and 4th Harvest		
		Mean	Range of Values*		Mean	Range of Values*		Mean	Range of Values*	
Dry Matter	% of total	85	77	- 93	85	79	- 91	74	60	- 88
Crude Protein	% of dm	8.3	5.9	- 10.6	12.8	10.5	- 15.1	17.0	14.8	- 19.3
ADICP	% of dm	0.74	0.51	- 0.98	0.59	0.41	- 0.78	0.52	0.32	- 0.72
Available CP	% of dm	8.2	5.9	- 10.6	12.8	10.5	- 15.1	17.0	14.8	- 19.3
Soluble CP	% of dm	26	18	- 33	29	24	- 35	33	30	- 36
ADF	% of dm	46	41	- 51	37	33	- 41	29	25	- 33
NDF	% of dm	70	64	- 76	61	55	- 66	50	45	- 55
Fat	% of dm	2.6	2.2	- 3.1	3.5	3.0	- 3.9	4.1	3.7	- 4.6
Ash	% of dm	6.6	5.5	- 7.6	8.2	7.1	- 9.3	9.5	8.3	- 10.7
Lignin	% of dm	5.3	2.7	- 8.0	5.6	2.8	- 8.4	5.5	2.9	- 8.1
NEL	Mcal/lb	0.40	0.32	- 0.47	0.53	0.47	- 0.59	0.65	0.59	- 0.71
TDN	% of dm	56	52	- 60	63	60	- 66	69	66	- 72
NFC	% of dm	15.8	11.2	- 20.4	19.5	14.7	- 24.4	25.1	19.9	- 30.3
RFV	none	71	60	- 83	94	80	- 107	125	106	- 145
DE	Mcal/lb	1.1	1.0	1.1	1.2	1.1	1.3	1.3	1.3	1.4
NDICP	% of dm	3.42	2.34	- 4.49	4.65	3.72	- 5.59	5.55	4.75	- 6.35
Lignin	% of NDF	10.3	5.7	- 14.9	11.2	6.8	- 15.6	12.5	7.1	- 17.8
ADICP	% of CP	9.7	5.8	- 13.6	4.7	2.9	- 6.6	3.0	2.0	- 4.0
NDICP	% of CP	42	31	- 53	37	31	- 42	33	28	- 38
Calcium	% of dm	0.54	0.39	- 0.68	0.53	0.41	- 0.66	0.61	0.49	- 0.74
Phosphorus	% of dm	0.25	0.19	- 0.30	0.35	0.30	- 0.40	0.42	0.36	- 0.47
Potassium	% of dm	1.3	0.8	- 1.8	2.0	1.5	- 2.5	2.8	2.4	- 3.3
Magnesium	% of dm	0.18	0.14	- 0.23	0.23	0.20	- 0.26	0.24	0.21	- 0.27
Sulfur	% of dm	0.15	0.11	- 0.19	0.21	0.17	- 0.24	0.25	0.21	- 0.29
No. of Samples		95			76			12		

*Equals 1.0 standard deviation which represents about 2/3's of the total samples that are distributed around the mean

For more information on forage management, quality and utilization, go to the Vermont Crops and Soils Homepage at <http://pss.uvm.edu/vtcrops/>.