Final Report (2006-07)

Assessing On-Farm Pasture Availability and Forage Quality for Dairy Feed Planning

S.C. Bosworth and M.P. Cannella, University of Vermont[1]

Introduction

Feed planning on pasture is an important management strategy for improving profitability for pasture-based dairy farms (Murphy, 1994). Prescribed grazing plans as required by the USDA Natural Resources and Conservation Service, rely on feed budgeting information (Kevin Kaija, personal communication). Yet, little on-farm information is available concerning pasture productivity, utilization and forage quality in New England states that can be used for planning purposes.

Objectives

1) To collect quantitative information on pasture production and quality for a variety of soil types and specie mixtures on Vermont farms,
2) To assess a method using on-farm records as a way to estimated pasture yield and availability as compared to more intensive hand sampling, and
3) To evaluate the impact of legume content on forage availability and quality.

Materials and Methods

Four grazing paddocks from two Vermont farms were monitored throughout the 2006 season in order to assess pasture growth rates, pre and post pasture mass, net mass, percent utilization, botanical composition, and pasture quality. The two farms participating in this project included Shelburne Farms of Shelburne, VT and Moultrup Farm of Richmond, VT. Both farms utilize a management intensive grazing system such that lactating cows are moved to new pasture between every milking. Shelburne Farms milks Brown Swiss cows and is located near Lake Champlain. Their pastures are on a variety of soils ranging from well-drained silt loams to moderate and poorly drained clays. The Moultrup farm milks Jersey cows and is located about 20 miles east of Shelburne and is adjacent to the Huntington River. Most of the pasture are fine and very fine sandy loam soils.

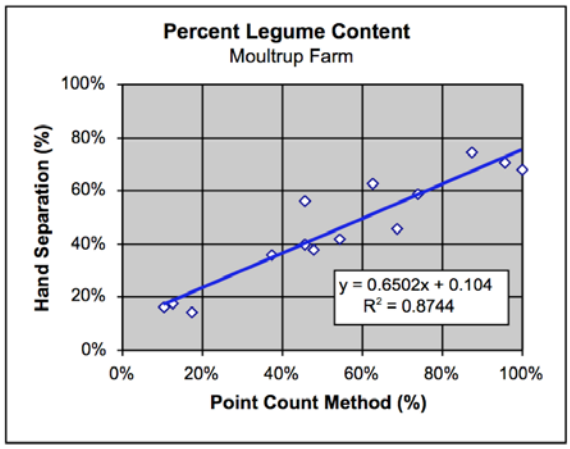
Pasture Mass and Dry Matter Yield – The day before and the day after each treatment paddock was grazed, a pre- and post-grazing measure of pasture yield was determined using the acrylic pasture plate method (Rayburn, 1997) taking the mean and standard deviation of 25 measurements per paddock. The difference between pre and post grazing yield was calculated as net pasture yield. Percent utilization was calculated by dividing net yield by pre-grazing yield times 100.

Pasture Quality and Botanical Composition – During each pre-grazing sampling, half of the 25 sites were hand sampled using a 2x2 ft wire quadrat placed over the plate meter. Forage was removed with hand clippers to a height similar to what the cows are observed to graze.

[1] Extension Associate Professor, Plant and Soil Science Dept. and Project Assistant (now a graduate student in the Department of Community Development and Applied Economics at University of Vermont)

A composite from all samples was thoroughly mixed and sub-sampled for quality analysis. Samples were sent to the University of Vermont Agricultural Testing Lab and analyzed for crude protein, soluble protein, acid detergent fiber (ADF), neutral detergent fiber (NDF), digestible NDF, net energy of lactation and minerals. A second sub-sample was hand separated into grasses, legumes, and forbs. Each was dried and weighed to determine percent botanical composition.

Indirect Method for Determining Legume Content – a point count method utilizing 24 equally spaced 3/8" holes drilled into the acrylic rising plate was found to correlate well to hand separations and was also used throughout the season to estimate legume content. Counts were made on each of the 25 rising plate points per paddock measurement.



Results

Growth and Pasture Utilization - Both farms in this project utilized managed intensive grazing as a method for pasturing their dairy animals (usually moving their milk cows to new paddocks between each milking). Pre-grazing mass was usually above 2500 lbs. per acre, more than adequate for optimum dry matter intake (Figure 1, Tables 2 and 4 in Appendix).

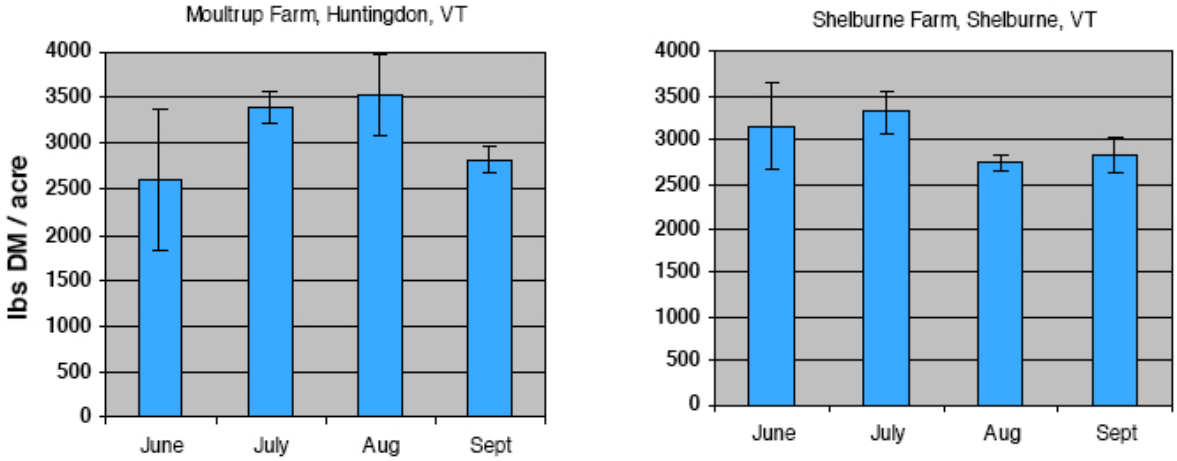


Figure 1. Pre-grazing mass means and standard deviations of the four paddocks from each farm through the 2006 grazing season

The Moultrup Farm utilized an average of 50% of their pasture each grazing (Figure 2, Table 2 in Appendix). Shelburne Farm had poorer utilization partially due to the excessive rain in 2006 along with their poorly drained soils (Figure 2, Table 4 in Appendix).

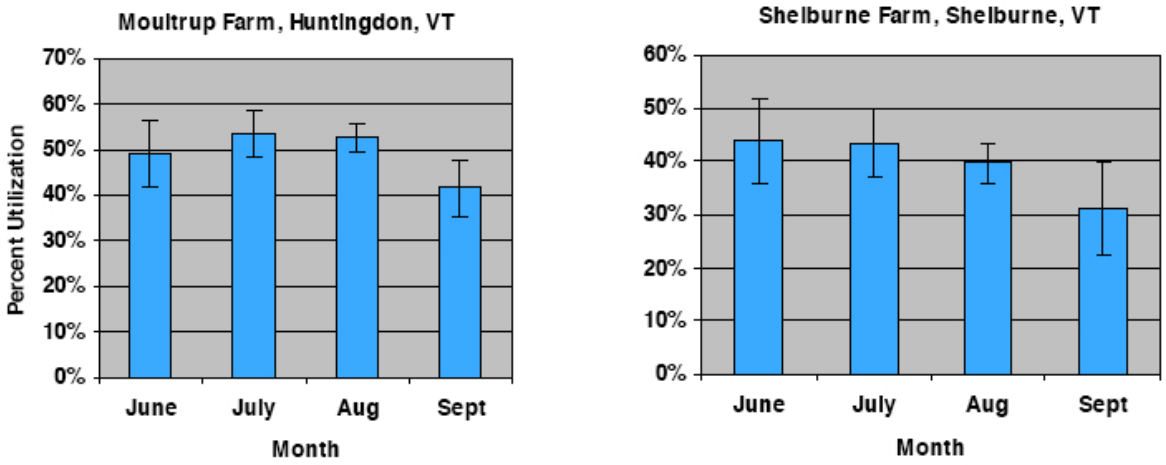


Figure 2. Pasture utilization means and standard deviations of the four paddocks from each farm through the 2006 grazing season

Pasture growth rates ranged from 38 to 98 lbs. per acre per day (Figure 3, Tables 2 and 4 in Appendix). The high amounts of rainfall in June seemed to enhance the pasture growth at the Moultrup farm which has a predominately course texture soil; whereas, the growth rate at Shelburne Farm was more variable across paddocks, particularly in the first half of the season when there was excessive rainfall.

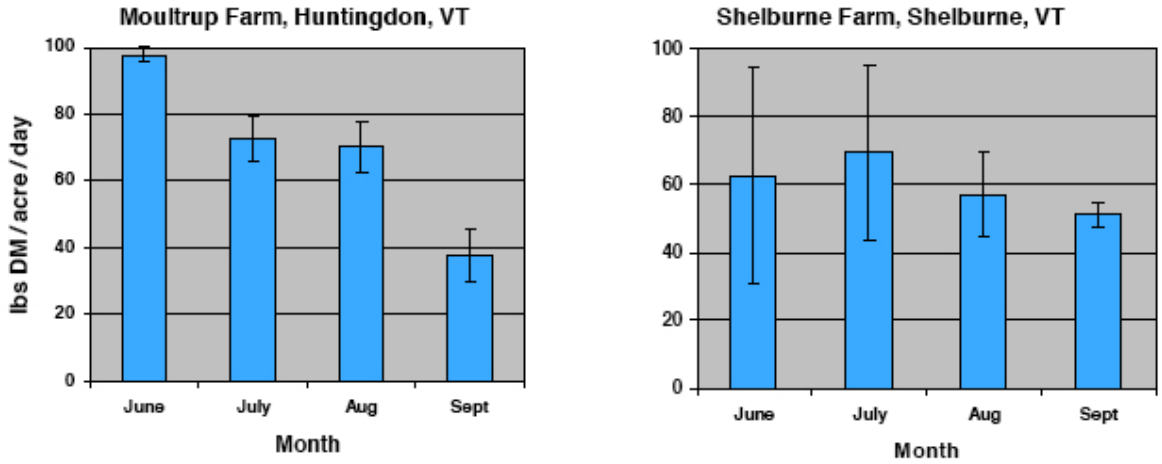


Figure 3. Pasture growth rate means and standard deviations of the four paddocks from each farm through the 2006 grazing season.

Legume Content - Legume content varied across paddocks but mostly varied with season (Figure 4, Tables 3 and 5 in Appendix). Generally, legume content increased as the season progressed with highest levels in August and September. Recently overseeded paddocks did not show any higher levels of legume content as compared to the non-overseeded ones except for Middle A and B at the Moultrup Farm. Jim's South and North paddocks were harvested for hay in the first cutting and then grazed which may explain why legume content was low in the first grazing. The wet fields at Shelburne Farms were difficult to graze in the first half of the season resulting in a higher amount of grass cover and low legume content.

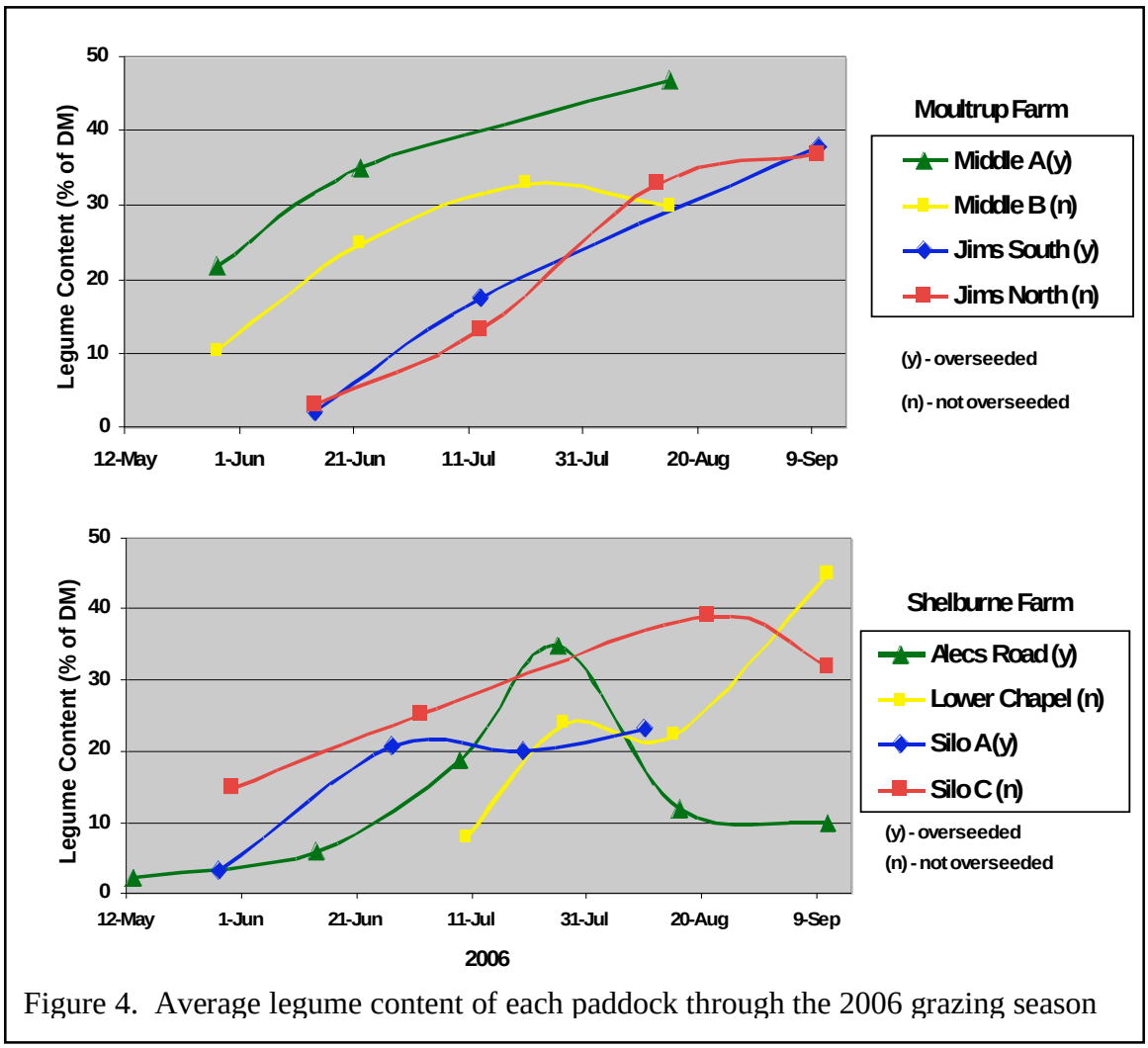


Figure 4. Average legume content of each paddock through the 2006 grazing season

Generally, legume content was only associated with higher pasture quality when it exceeded 30 percent of the botanical mixture; however, the relationship varied greatly and was also influenced by time of year (Figure 5, Tables 3 and 5 in Appendix).

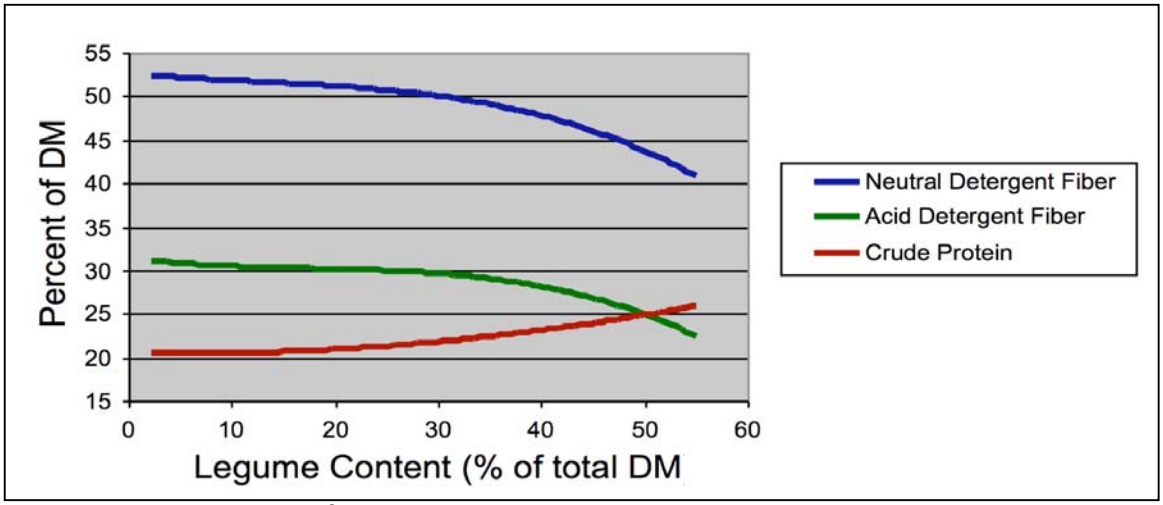


Figure 5. Relationship of legume content to NDF, ADF and crude protein across all paddocks on both farms for the 2006 grazing season.

Calcium was the only mineral that significantly correlated with legume content (Table 1)

Table 1. Correlation coefficients of legume content with various forage quality parameters.

Parameter	Correlation coefficient	Significance
Crude protein	0.41	*
Soluble protein	0.00	ns
Acid detergent fiber	-0.58	**
Neutral detergent fiber	-0.57	**
Net Energy of Lactation	0.53	**
Total digestible nutrients	0.58	**
Phosphorus	0.08	ns
Potassium	-0.09	ns
Magnesium	0.28	ns
Calcium	0.54	**

On-Farm Records

Using on-farm records to estimate net pasture yield showed a similar result to intensive hand sampling utilizing an acrylic pasture plate method (Figure 6).

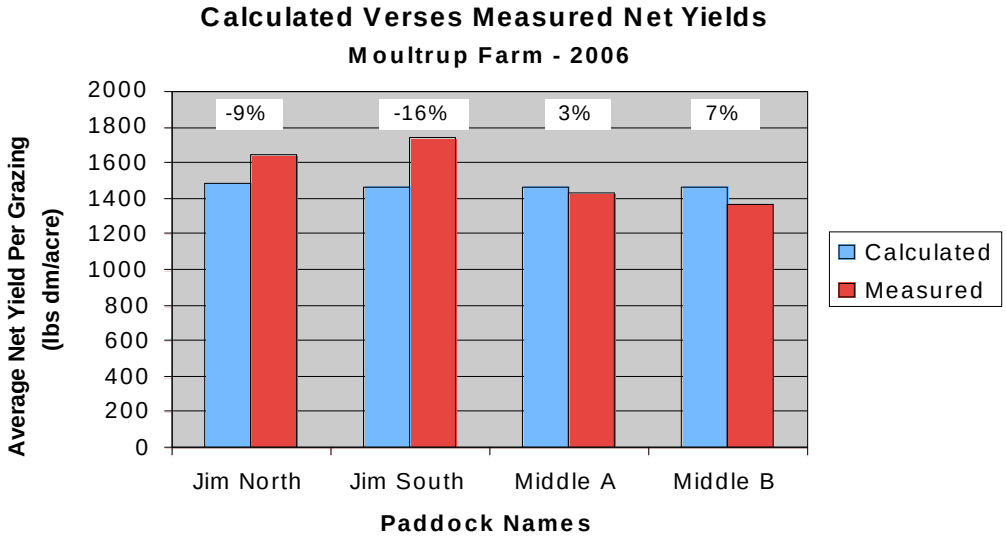


Figure 6. Net yields per grazing period averaged over the grazing season. *Calculated* yields were determined from estimating dry matter intake using on-farm records of milk production, fat composition and animal weight. *Measured* net yields were determined from the rising plate pre and post grazing yields.

Summary

On farm records have the potential to be used as a tool for estimating pasture productivity; however, indirect methods such as the use of a rising plate and point count methods for determining legume content can also enhance the data by estimating pounds of pre-grazing cover, percent utilization, and residual dry matter. These tools are relatively inexpensive to make and can be quite useful for collecting pasture data that can be used in feed planning, fine tuning a grazing program, extension demonstrations, or on-farm research.

References

Murphy, William. 1994. Greener pastures on your side of the fence (4th ed.). Arriba Publishing, Colchester, VT.

Rayburn, Edward. 1997. An acrylic plastic weight plate for estimating forage yield. West Virginia Un. Extension Service (http://www.caf.wvu.edu/~forage/pastplate.htm)

Acknowledgements

This project could not have been accomplished without the help, guidance and assistance of Nat Bacon of Shelburne Farms and Jeff Moultrup of Moultrup Farms.

The project was supported by the Northeast USDA-SARE program (http://www.uvm.edu/~nesare/index.html) through a Partnership Grant.

More information about pasture and grazing management in Vermont can be found at the following websites:

Vermont Crops and Soils Homepage: http://pss.uvm.edu/vtcrops/?Page=pasturegrazing.html

Vermont Pasture Network: http://www.uvm.edu/~pasture/

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

Table 2. Paddock area, soil type, treatments and grazing information for Moultrup Farm in 2006, Richmond, VT

Paddock Name	Area	Over seeded with legume	Grazing Date	Rest Period	Growth Rate	Pre Mass	Post Mass	Net Mass	Forage Utili-zation	Measured Intake		Calculated Intake*
	acres			*days*	*lbs/a/d*	*lb/a*	*lb/a*	*lbs/a*	*%*	*lbs/d*	*lbs/cow/d*	*lbs/cow/d*
Jim North	0.90	No	6/15	-	-	3080	1369	1711	56%	1540	25.7	22.8
Predominate soil type: Agawam fine sandy loam 0 - 5% slope			7/14	28	76.5	3436	1771	1665	48%	1499	23.1	20.6
			8/14	30	70.2	3737	1850	1887	51%	1699	25.7	20.4
			9/11	27	32.1	2684	1400	1284	48%	1156	17.5	19.8
			Average	**28**	**59.6**	**3234**	**1597**	**1637**	**51%**	**1473**	**23.0**	**20.9**
Jim South	0.90	Yes	6/15	-	-	3431	1533	1898	55%	1709	28.5	21.1
Predominate soil type: Agawam fine sandy loam 0 - 5% slope			7/14	28	76.2	3590	1813	1777	49%	1599	24.6	20.6
			8/14	30	79.0	4026	1959	2067	51%	1860	28.2	20.8
			9/11	27	34.4	2854	1640	1214	43%	1093	16.6	19.8
			Average	**28**	**63.2**	**3475**	**1736**	**1739**	**50%**	**1565**	**24.5**	**20.6**
Middle A	0.90	Yes	5/29	-	-	2056	1155	900	44%	810	14.7	22.6
Predominate soil type: Agawam fine sandy loam 0 - 5% slope			6/23	24	99.6	3347	1384	1963	59%	1766	29.0	21.1
			7/22	28	62.7	3014	1470	1545	51%	1390	21.1	21.1
			8/16	24	67.2	3016	1706	1311	43%	1180	17.9	20.6
			9/14	28	-	-	-	-	-	-	-	19.5
			Average	**26**	**76.5**	**3126**	**1520**	**1606**	**51%**	**1445**	**22.6**	**20.6**
Middle B	0.90	No	5/29	-	-	1832	1064	768	42%	691	12.6	22.6
Predominate soil type: Agawam fine sandy loam 0 - 5% slope			6/23	24	96.3	3184	1369	1814	57%	1633	26.3	21.1
			7/22	28	75.2	3326	1425	1901	57%	1711	25.9	21.1
			8/16	24	60.4	2753	1846	907	33%	816	12.4	20.8
			9/14	28	47.0	2926	1482	1444	49%	1300	19.7	19.2
			Average	**26**	**69.7**	**2804**	**1531**	**1517**	**49%**	**1365**	**21.1**	**20.5**
			Farm Average	**27**	**67.3**	**3160**	**1596**	**1625**	**50%**	**1462**	**22.8**	**20.6**

*Calculated intake per cow per day is based on average cow weight and daily milk production

Table 3. Legume content and pasture quality for each grazing period at Moultrup Farm in 2006, Richmond, VT

Paddock Name	Over seeded with legume	Grazing Date	Legume Content	CP*	Soluble Protein	ADF	NDF	NEl	TDN	Ca	P	K	Mg
			% of DM	*%*	*%*	*%*	*%*	*Mcal/lb*	*%*	*%*	*%*	*%*	*%*
Jim North	No	6/15	3%	21.9	47.3	30.7	52.1	0.62	68	0.56	0.46	3.23	0.20
		7/14	13%	22.4	41.3	30.3	53.3	0.63	68	0.55	0.43	3.70	0.21
		8/14	33%	22.3	44.1	26.9	47.9	0.68	71	0.55	0.41	3.43	0.19
		9/11	37%	29.0	46.7	25.8	45.5	0.70	72	0.75	0.51	3.62	0.25
		Average	**22%**	**23.9**	**44.9**	**28.4**	**49.7**	**0.66**	**70**	**0.60**	**0.45**	**3.50**	**0.21**
Jim South	Yes	6/15	2%	21.1	46.8	31.6	53.5	0.61	67	0.56	0.44	3.45	0.20
		7/14	18%	23.0	42.4	31.4	54.5	0.61	68	0.56	0.46	3.75	0.23
		8/14	14%	21.8	44.5	27.9	49.9	0.67	70	0.45	0.38	3.59	0.18
		9/11	38%	28.5	48.1	26.6	45.4	0.69	71	0.74	0.54	3.65	0.24
		Average	**18%**	**23.6**	**45.5**	**29.4**	**50.8**	**0.65**	**69**	**0.58**	**0.46**	**3.61**	**0.21**
Middle A	Yes	5/29	22%	25.0	47.8	30.4	53.1	0.63	68	0.63	0.47	3.43	0.22
		6/23	35%	18.9	46.5	28.4	49.4	0.66	70	0.53	0.36	3.17	0.18
		7/22	-	-	-	-	-	-	-	-	-	-	-
		8/16	47%	24.0	44.0	28.6	48.6	0.66	70	0.83	0.43	3.41	0.25
		9/14	-	-	-	-	-	-	-	-	-	-	-
		Average	**35%**	**22.6**	**46.1**	**29.1**	**50.4**	**0.65**	**69**	**0.66**	**0.42**	**3.34**	**0.22**
Middle B	No	5/29	10%	23.5	45.6	29.2	51.5	0.65	69	0.38	0.45	3.39	0.18
		6/23	25%	16.6	49.7	33.2	58.6	0.59	66	0.66	0.35	2.24	0.20
		7/22	33%	21.5	42.7	32.0	53.2	0.61	67	0.68	0.43	3.42	0.22
		8/16	30%	21.2	46.4	29.4	49.9	0.64	69	0.79	0.40	3.26	0.24
		9/14	-	-	-	-	-	-	-	-	-	-	-
		Average	**25%**	**20.7**	**46.1**	**31.0**	**53.3**	**0.62**	**68**	**0.63**	**0.41**	**3.08**	**0.21**
		Farm Average	**25%**	**22.7**	**45.6**	**29.5**	**51.0**	**0.64**	**69**	**0.62**	**0.43**	**3.38**	**0.21**

*CP - crude protein; ADF - acid detergent fiber; NDF - neutral detergent fiber; TDN - Total digestible nutrients

Table 4. Paddock area, soil type, treatments and grazing information for Shelburne Farm in 2006, Shelburne, VT

Paddock Name	Area	Over seeded with legume	Grazing Date	Rest Period	Growth Rate	Pre Mass	Post Mass	Net Mass	Forage Utili-zation	Measured Intake		Calculated Intake*
	acres			*days*	*lbs/a/d*	*lb/a*	*lb/a*	*lbs/a*	*%*	*lbs/d*		*lbs/cow/d*
Alec Road	3.50	Yes	5/14	-	-	3009	2352	656	22%	2297	-	22.8
	Predominate soil types:		6/15	31	16.8	2805	1573	1232	44%	2875	-	20.7
	80% Palatine silt loam		7/10	24	93.3	3533	2070	1462	41%	3412	-	21.2
	20% Vergennes clay		7/27	16	80.2	3193	1831	1363	43%	3180	-	20.5
			8/16	19	53.3	2630	1784	846	32%	2960	-	20.6
			9/12	26	53.7	3128	1987	1141	36%	3994	-	20.6
			Average	**23**	**59.5**	**3050**	**1933**	**1117**	**36%**	**3120**	-	**21.1**
Lower Chap	3.90	No	5/25	-	-	3607	2026	1581	44%	4110	-	21.8
	Predominate soil types:		7/11	46	30.1	3322	2369	953	29%	2479	-	20.6
	50% Palatine silt loam		7/28	16	31.6	2843	1837	1006	35%	2616	-	20.8
	50% Vergennes clay		8/16	18	67.7	2852	1784	1068	37%	2777	-	19.8
			9/12	26	47.7	2786	2178	608	22%	2372	-	20.1
			Average	**27**	**44.3**	**3082**	**2039**	**1043**	**33%**	**2871**	-	**20.6**
Silo A	6.50	Yes	5/29	-	-	2659	1754	906	34%	3924	-	21.6
	Predominate soil types:		6/28	29	64.4	3299	1527	1772	54%	3840	-	21.3
	56% Stockbridge stony loam		7/21	22	75.7	2965	1567	1398	47%	3029	-	21.0
	24% Palatine silt loam		8/11	20	66.3	2695	1535	1160	43%	3015	-	20.8
	20% Covington silty clay		9/4	23	54.6	2682	1981	701	26%	3037	-	20.4
			Average	**24**	**65.3**	**2860**	**1673**	**1187**	**41%**	**3369**	-	**21.0**
Silo C	7.80	No	7/3	-	-	3533	1638	1895	54%		-	20.8
	Predominate soil types:		7/25	21	90.1	3439	1725	1714	50%	3342	-	20.7
	70% Covington silty clay		8/22	27	41.4	2802	1796	1006	36%	2616	-	20.1
	22% Stockbridge stony loam		9/12	20	48.5	2716	1622	1095	40%	2846	-	20.7
	5% Palatine silt loam		**Average**	**23**	**60.0**	**3122**	**1695**	**1427**	**45%**	**2935**	-	**20.6**
			Farm Average	**24**	**57.2**	**3028**	**1835**	**1194**	**39%**	**3073**	-	**20.8**

*Calculated intake per cow per day is based on average cow weight and daily milk production

Table 5. Legume content and pasture quality for each grazing period Shelburne Farm in 2006, Shelburne, VT

Paddock Name	Over seeded with legume	Grazing Date	Legume Content	CP*	Soluble Protein	ADF	NDF	Nel	TDN	Ca	P	K	Mg
			% of DM	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*
Alec Road	Yes	5/14	2%	25.2	44.1	27.1	55.7	0.60	66.7	0.33	0.47	3.83	0.21
		6/15	6%	19.5	48.1	31.7	51.4	0.61	67.3	0.47	0.40	3.61	0.21
		7/10	19%	20.5	46.7	29.3	46.3	0.65	69.2	0.68	0.41	3.84	0.23
		7/27	35%	21.3	43.3	28.1	48.1	0.66	70.1	0.49	0.37	4.13	0.22
		8/16	-	22.5	42.3	30.3	51.1	0.63	68.4	0.56	0.42	3.92	0.24
		9/12	20%	21.0	43.8	27.2	45.6	0.68	70.9	0.35	0.35	3.63	0.21
		Average	**16%**	**21.7**	**44.7**	**29.0**	**49.7**	**0.64**	**69**	**0.48**	**0.40**	**3.83**	**0.22**
Lower Chap	No	5/25	-	22.0	38.5	28.7	54.1	0.66	69.7	0.32	0.29	3.09	0.20
		7/11	8%	16.4	46.0	30.8	52.5	0.62	68.0	0.48	0.31	3.20	0.21
		7/28	24%	20.4	43.6	33.7	55.0	0.58	65.7	0.73	0.40	3.47	0.28
		8/16	22%	20.2	42.1	27.9	47.8	0.67	70.3	0.66	0.33	3.27	0.25
		9/12	45%	25.0	46.0	21.9	40.3	0.70	75.1	0.63	0.37	3.08	0.21
		Average	**25%**	**20.8**	**43.2**	**28.6**	**49.9**	**0.65**	**70**	**0.56**	**0.34**	**3.22**	**0.23**
Silo A	Yes	5/29	3%	19.2	53.1	34.2	57.4	0.57	65.2	0.50	0.41	3.51	0.19
		6/28	21%	22.0	46.2	30.2	49.1	0.63	68.5	0.57	0.41	3.39	0.22
		7/21	20%	22.4	41.6	30.0	51.6	0.63	68.6	0.41	0.39	3.90	0.22
		8/11	23%	21.2	42.5	31.5	51.0	0.61	67.4	0.59	0.38	3.88	0.25
		9/4	-	25.3	45.3	25.8	45.5	0.70	72.0	0.84	0.43	3.61	0.25
		Average	**17%**	**22.0**	**45.7**	**30.3**	**50.9**	**0.63**	**68**	**0.58**	**0.40**	**3.66**	**0.23**
Silo C	No	7/3	25%	16.4	52.9	32.1	52.7	0.60	66.9	0.67	0.34	2.69	0.20
		7/25	26%	16.9	44.0	34.0	54.9	0.57	65.4	0.63	0.34	3.27	0.23
		8/22	39%	21.8	48.0	30.1	46.9	0.63	68.6	0.86	0.37	3.27	0.26
		9/12	16%	22.3	46.2	30.8	52.2	0.62	67.9	0.58	0.37	3.18	0.24
		Average	**27%**	**19.4**	**47.8**	**31.8**	**51.7**	**0.61**	**67**	**0.69**	**0.36**	**3.10**	**0.23**
		Farm Average	**21%**	**21.0**	**45.4**	**29.9**	**50.6**	**0.63**	**69**	**0.58**	**0.38**	**3.45**	**0.23**

*CP - crude protein; ADF - acid detergent fiber; NDF - neutral detergent fiber; TDN - Total digestible nutrients