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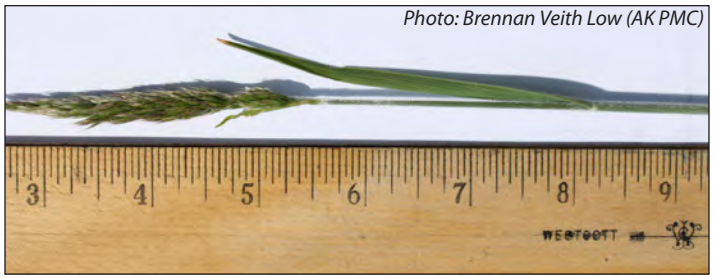
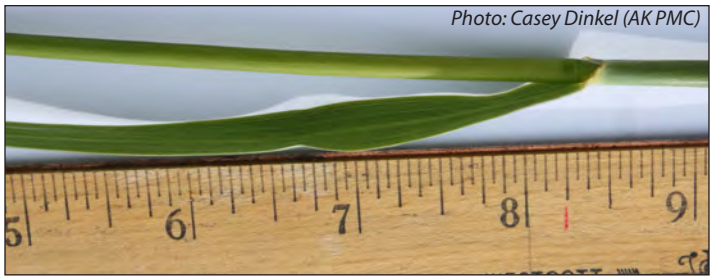
Appendix A: Nutrient Study

(Analysis of Collected Plant Nutritional Quality Data at Different Growth Stages)





Detailed measurements of nutrient availability at various plant growth stages were taken during this study.

Introduction

Forage production in Alaska presents unique challenges, due to the short growing season (100-118 days) and harsh environments encountered throughout diverse regions of the state. Spring planting is optimal, as planted species are able to utilize available moisture from winter snowmelt and take advantage of the warmer temperatures and longer days of summer. Average summer temperatures in Alaska range from 51 - 61˚F, with an 18 to 24 hour photo period in June.

Though these climatic factors present some challenges, forage production numbers are stable. The mean per ton cost varies largely in Alaska, from $225/ton - $750/ton, considerably higher than the $90 per ton common in the lower 48. The high price variability can be attributed to high production costs, a shortage of available hay and uncontrollable climate variables. To adapt to and overcome Alaska's climate and geography, managers should choose forage species with high nutritional value. This will enable an animal's nutrient intake levels to be met while minimizing the expense of nutritional supplements.

Purpose

The goal of this study was to determine nutrient content of forage species within each distinct plant growth stage. Five growth stages were examined for grass, legume, and cereal crop species - Vegetative, Pre-boot, Boot, Anthesis (flowering) and Caryopsis (ripening). Samples of vegetative matter were taken at each stage and sent to a lab for nutrient analysis. Data extrapolated from testing can be used by producers and consumers as a means of choosing forage species based on the needs of livestock and/or wildlife.

An additional intent of this study was to look at the nutritional content of native and non-native plant species, and determine if any non-native species have sufficiently high nutritional value to warrant inclusion in forage plantings in Alaska. Timothy and Brome are two examples of non-native species with high nutritional value.

Methods & Procedures

This effort was conducted at Alaska Plant Materials Center in Palmer, Alaska during the 2011 growing season. Fields were well established and fairly free of weeds. Plant species were evaluated and growth stages were monitored daily. Each species collection was accompanied by field observations as noted by the sample collector. Standardized collection procedures were followed.

Growth State Indicators

1. **Vegetative**: Leaf growth and development; no stems
2. **Pre-boot**: Stem elongation or "jointing"; stem or culm development occurs
3. **Boot**: The seedhead (inflorescence) emerges from the tiller
4. **Anthesis** (flowering): Pollen starts to shed from the anthers
5. **Ripening**: This stage begins with the development of the caryopsis (seed) and ceases when they are ripe. Also denotes the end of the growing season; leaves start to change color.

Species Collection

1. A handful of grass was clipped with scissors, leaving about 2-3 inches of stubble above ground. Five samples were collected for each species.
2. Each sample was cut into sections of approximately 8 inches in length, placed into a five gallon bucket and then mixed together so representative samples could be taken. Any decadent (previous year's) growth was removed so that only the current season's growth was analyzed.
3. Approximately 200 grams of grass was removed from the five gallon bucket and put into a ½ gallon bag. Each bag was labeled with date, species name, and growth stage.
4. Samples collected were delivered the same day to the University of Alaska Fairbanks Experiment Farm for testing.

Lab Analysis

Samples were collected from well established fields near the Plant Materials Center in Palmer, Alaska. The samples were gathered during the following growth stages; Vegetative, Pre-boot, Boot, Anthesis (flowering) and Ripening. The rationale of collecting samples in these growth stages was to determine the gain and loss of nutrients throughout a typical graminoid life cycle.

Samples submitted for analysis were tested for crude protein (**CP**) , minerals, acid detergent fiber (**ADF**), neutral detergent fiber (**NDF**), total digestible nutrients (**TDN**) and various other constituents. ADF and NDF are used to measure the portion of indigestible material within the sample, which inversely correlates to nutrient content.

The relative feed value (**RFV**) is an estimate of forage quality and is calculated from ADF and NDF percentages. The RFV grading system assumes that full bloom alfalfa has an RFV of 100; this legume is typically used as a baseline reference for grading forage. The RFV for each grass species within this study was calculated for all five growth stages. Results can be compared to the ranges given in the table below, developed by the American Forage and Grassland Council as a guideline for measuring forage quality.

Forage Grade	ADF	NDF	RFV
Prime	Under 30%	Under 40%	Over 151
1 (Premium)	31% - 35%	41% - 46%	150-125
2 (Good)	36% - 40%	47% - 53%	124-103
3 (Fair)	41% - 42%	54% - 60%	102-87
4 (Poor)	43% - 45%	61% - 65%	86-75
5 (Very Poor)	Over 46%	Over 66%	Under 74

Report of Findings

As expected, all grass species showed higher crude protein values during the vegetative and pre-boot (early growth cycle) stages. Decline in protein levels became evident after boot stage, though indigestible nutrients (fiber) began to increase. Other essential minerals like phosphorus (**P**), potassium (**K**), and Calcium (**Ca**) were measured in higher levels during the early growth stages and began to drop as plant species neared maturity. Acid and Neutral detergent fiber percentages increased steadily throughout the plant's life cycle, lowering the relative feed value and total digestible nutrients percentage of each forage species.

This nutrient assessment can assist growers in determining the best possible time to harvest forage based on the needs of their livestock and/or wildlife. If a grower seeks high quality and/or high nutrient forage, grasses should be harvested during an earlier growth such as the boot stage. When high production yield is the goal, grasses should be harvested later, during the anthesis and/or flowering stage. Scheduling the harvest based on stages of plant development can be a reliable way to obtain a desired yield and/or quality forage from year to year.

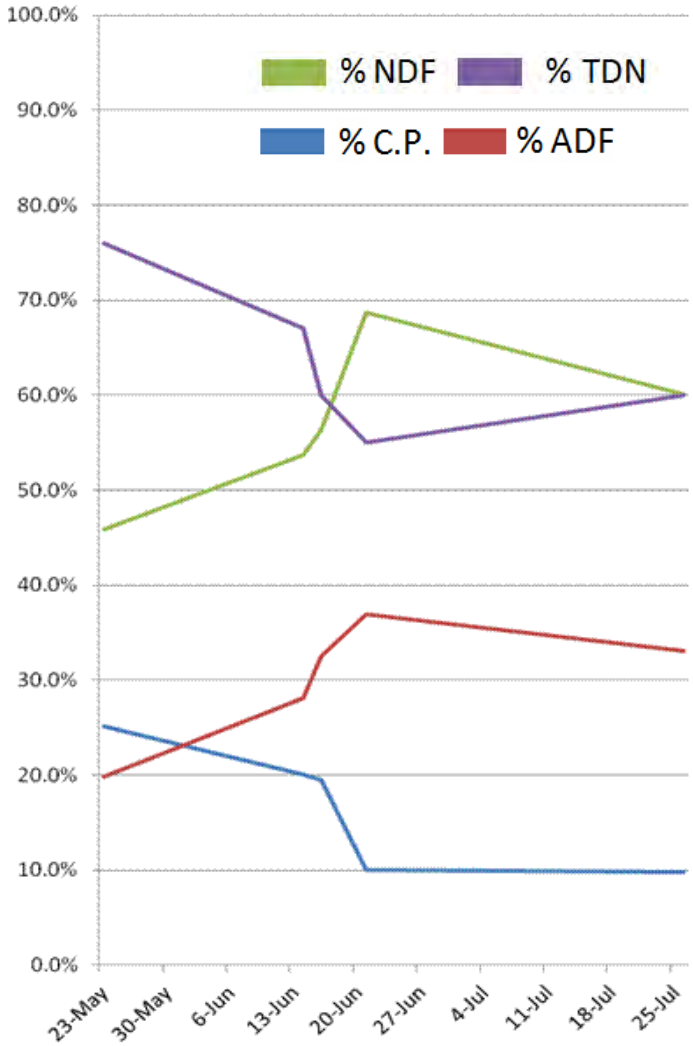
Graph Interpretation

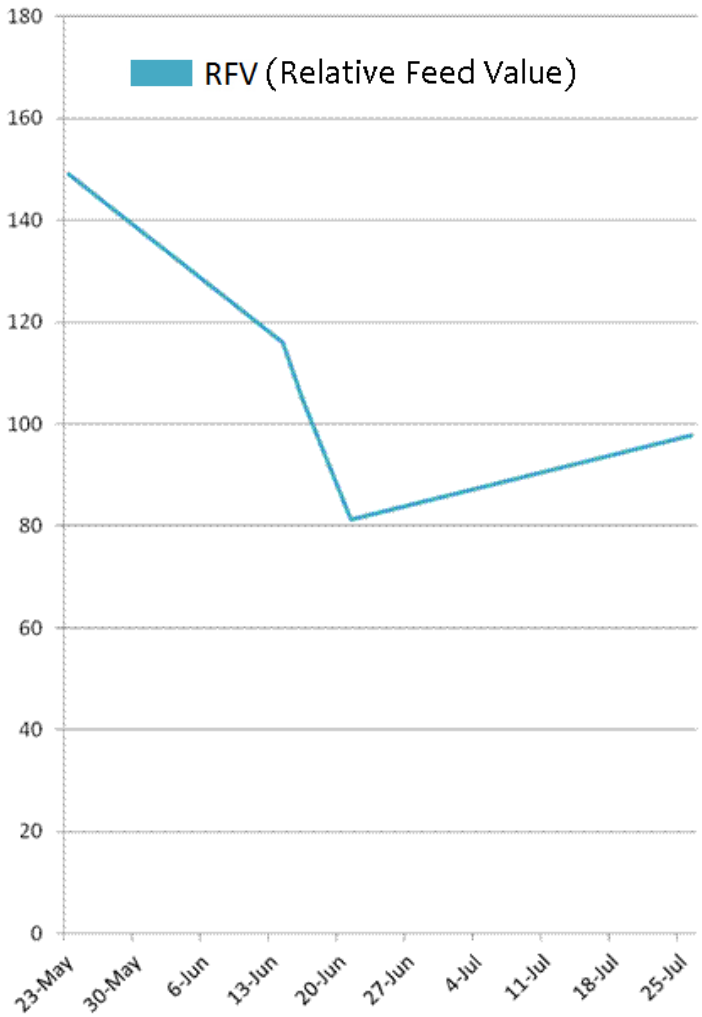
When interpreting data in the Nutrient Study, one should be aware of several characteristics associated with the following graphs. In general, Relative Feed Value (RFV), Crude Protein (CP) and Total Digestible Nutrient (TDN) values will decrease with time as a plant matures through the growing season. Contrarily, Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) values should typically increase with time and plant maturity. Pronounced increases or decreases (spikes) within the graphs can be attributed to the variability in randomly selected forage samples.

All data within the graphs of this study are displayed, so the reader may compare nutrient values and trends with other grass species. While not presented in graph form, values for phosphorus (P), potassium (K), calcium (Ca), in-vitro dry matter digestibility (IVDMD), metabolized energy, net energy, and dry matter (DM) are listed in a table for each grass species.

Alpine Bluegrass, *Poa alpina*

Moisture Free												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 23rd	25.11	0.28	1.77	0.51	19.82	45.88	77	76	1.33	0.92	149	95.8
Pre-Boot: June 14th	19.47	0.32	2.15	0.46	32.52	56.35	63	60	1.02	0.67	105	95.70
Boot: June 16th	20.03	0.38	2.51	0.43	28.12	53.67	69	67	1.14	0.77	116	95.52
Anthesis: June 21st	10.05	0.26	1.85	0.23	36.98	68.74	57	55	0.91	0.58	81	96.97
Ripening: July 26th	9.80	0.25	1.01	0.34	33.11	60.07	62	60	1.01	0.66	98	97.59



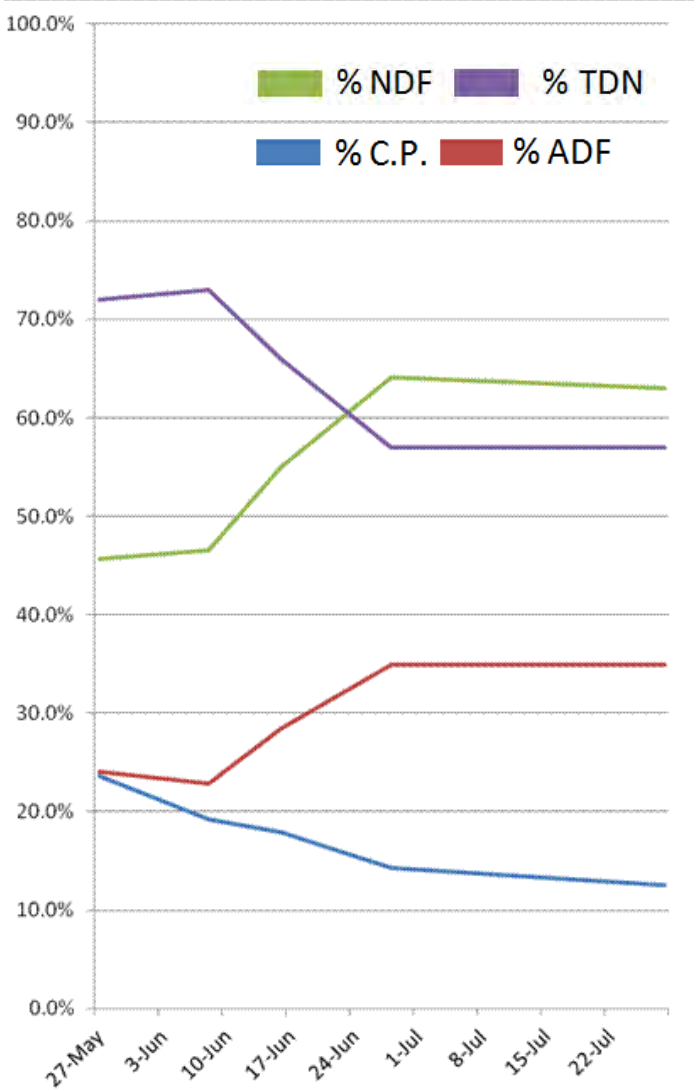


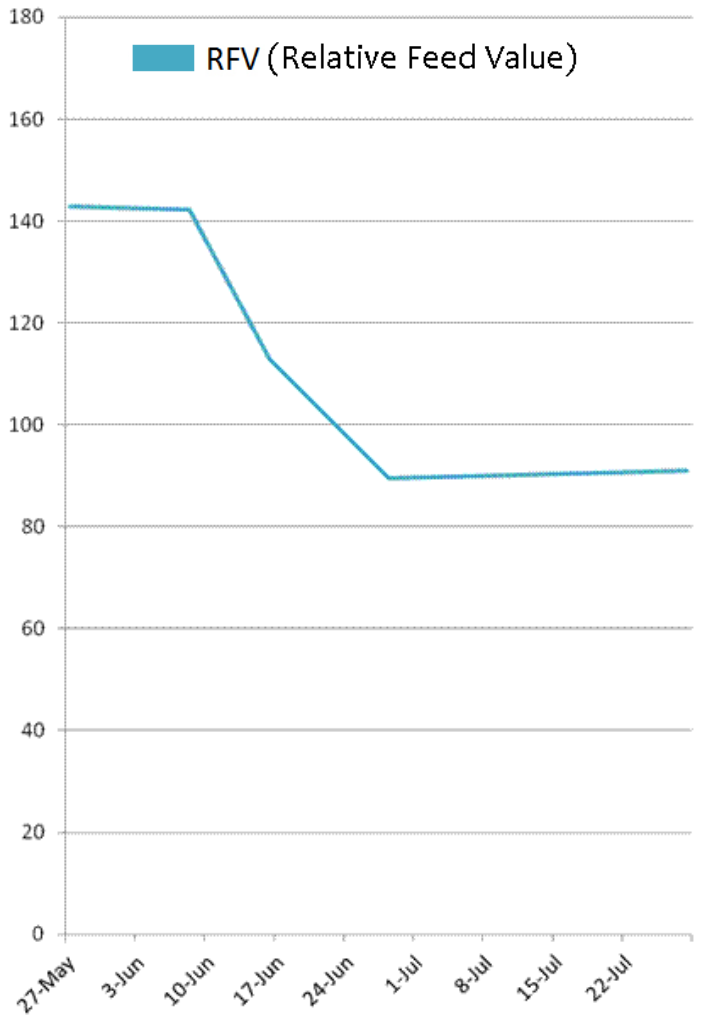
As Fed												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 23rd	6.50	0.07	0.46	0.13	5.13	11.87	19.93	19.67	0.34	0.24	39.0	25.88
Pre-Boot: June 14th	5.09	0.08	0.56	0.12	8.50	14.74	16.47	15.69	0.27	0.18	27.4	26.15
Boot: June 16th	5.66	0.11	0.71	0.12	7.95	15.18	19.51	18.95	0.32	0.22	32.8	28.28
Anthesis: June 21st	2.60	0.07	0.48	0.06	9.55	17.76	14.72	14.21	0.24	0.15	21.0	25.83
Ripening: July 26th	4.17	0.11	0.43	0.14	14.09	25.56	26.00	26.00	0.43	0.28	42.00	42.55

American Sloughgrass, *Beckmannia syzigachne*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	23.61	0.26	1.73	0.33	24.07	45.64	74	72	1.25	0.86	143	95.86
Pre-Boot: June 8th	19.22	0.34	2.83	0.43	22.88	46.49	75	73	1.28	0.88	142	98.24
Boot: June 16th	17.91	0.30	3.30	0.27	28.44	54.99	68	66	1.14	0.76	113	95.97
Anthesis: June 28th	14.27	0.29	2.06	0.28	34.88	64.07	60	57	0.96	0.62	90	95.90
Ripening: July 28th	12.56	0.27	1.59	0.30	34.86	63.05	60	57	0.96	0.62	91	97.55





As Fed

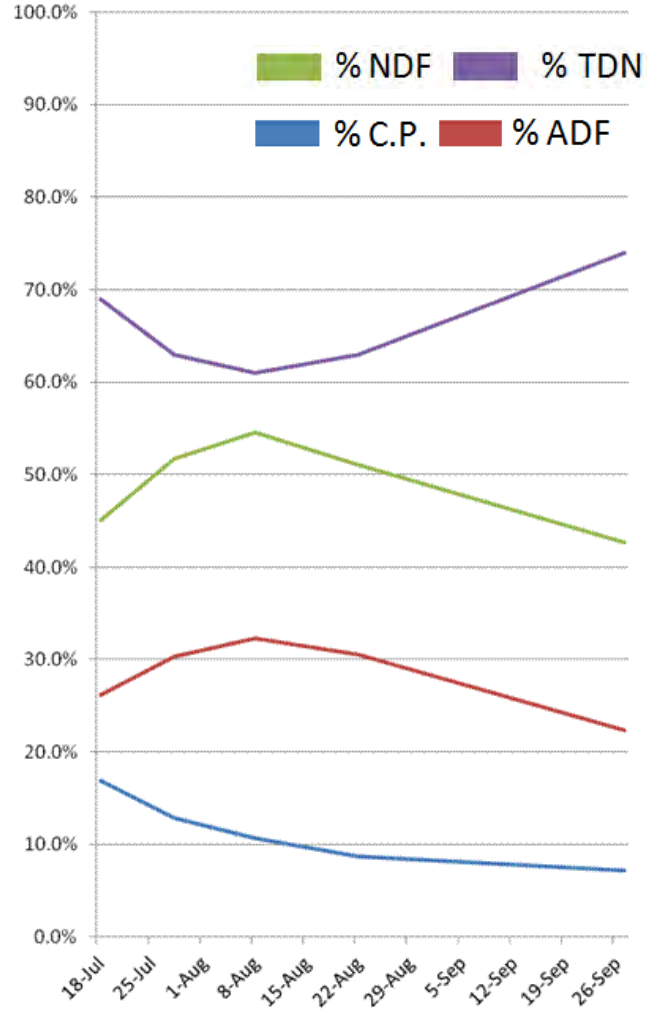
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	5.36	0.06	0.39	0.07	5.47	10.36	16.81	16.35	0.28	0.20	32.00	22.71
Pre-Boot: June 8th	2.57	0.04	0.38	0.06	3.06	6.23	10.04	9.77	0.17	0.12	19.04	13.39
Boot: June 16th	2.80	0.05	0.52	0.04	4.45	8.61	10.65	10.34	0.18	0.12	17.68	15.66
Anthesis: June 28th	2.50	0.05	0.36	0.05	6.12	11.24	11.00	10.00	0.17	0.11	16.00	17.55
Ripening: July 28th	4.33	0.09	0.55	0.10	12.01	21.72	21	20	0.33	0.21	31	34.56

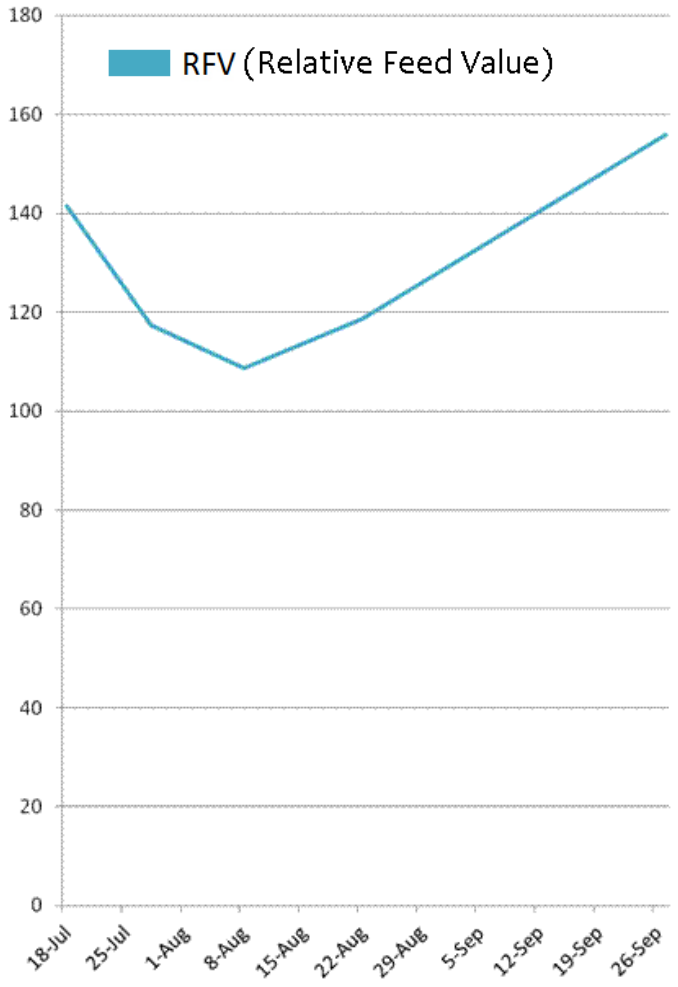
Annual Rye, *Lolium multiflorum*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 18th	16.86	0.35	4.15	0.59	26.18	45.06	71	69	1.20	0.81	141	97.13
Pre-Boot: July 28th	12.82	0.33	2.82	0.52	30.37	51.75	66	63	1.08	0.72	117	97.52
Boot: August 8th	10.73	0.25	1.71	0.48	32.34	54.52	63	61	1.03	0.68	109	97.28
Anthesis: August 22nd	8.70	0.25	1.27	0.46	30.52	51.06	65	63	1.08	0.72	119	97.69
Ripening: September 27th	7.15	0.23	0.59	0.32	22.40	42.62	75	74	1.29	0.89	156	96.98

* *note - this sample was not taken from an established field; samples were taken from 1st year planting - planting date June 25th*





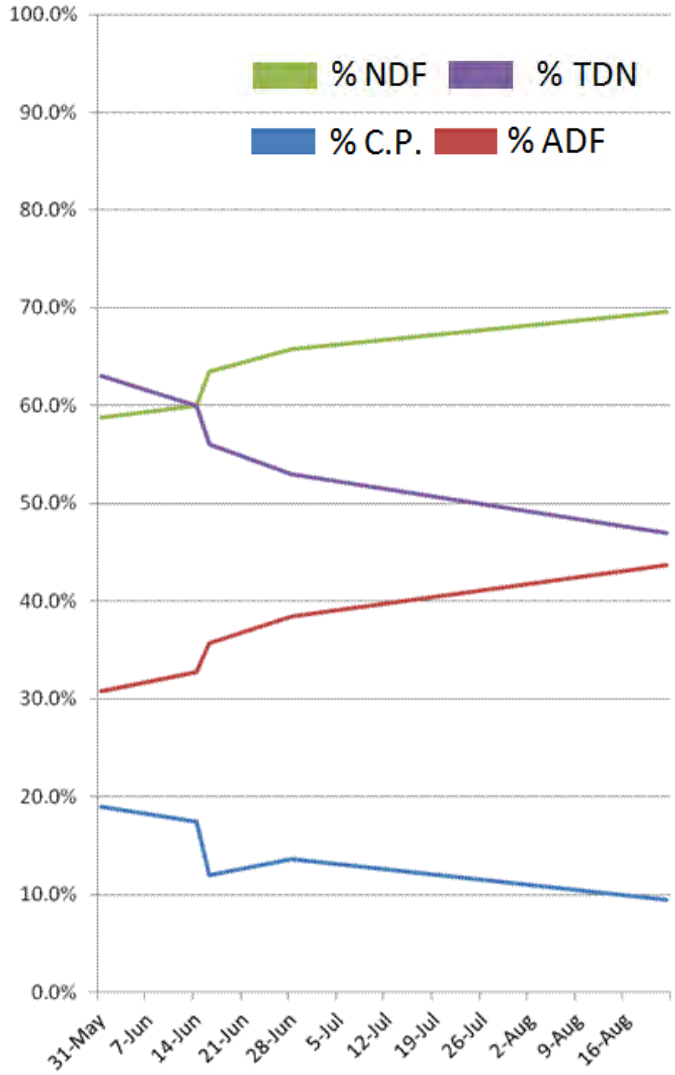
As Fed

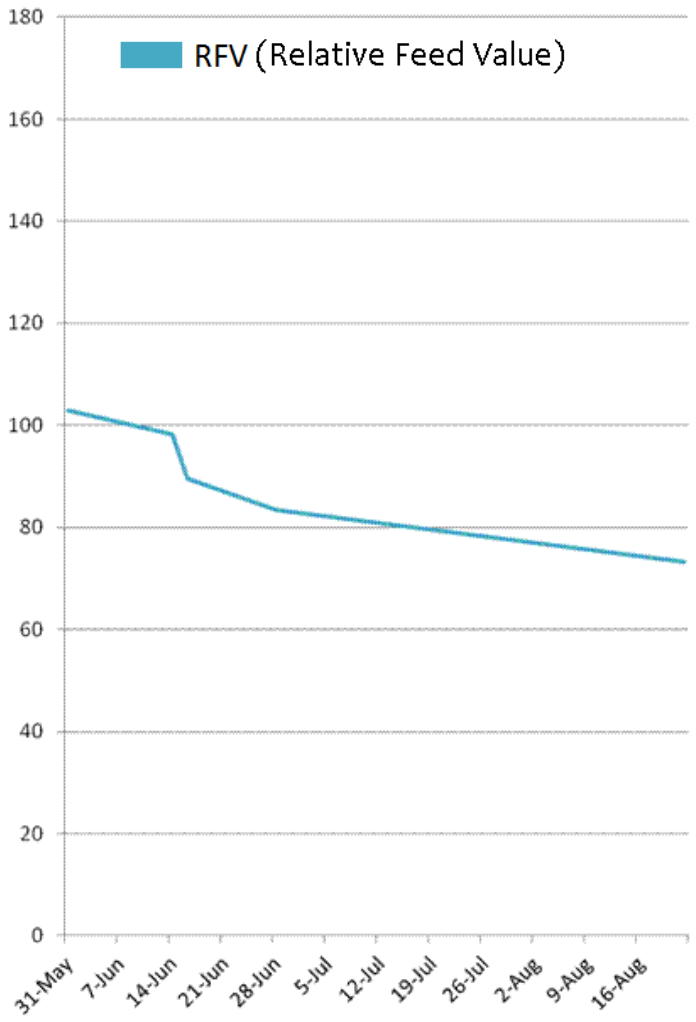
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 18th	1.91	0.04	0.47	0.07	2.97	5.11	8	8	0.14	0.09	16	11.34
Pre-Boot: July 28th	2.52	0.06	0.55	0.10	5.97	10.17	13	12	0.21	0.14	23	19.66
Boot: August 8th	2.93	0.06	0.38	0.11	7.20	12.14	14	14	0.23	0.15	24	22.26
Anthesis: August 22nd	2.52	0.07	0.37	0.13	8.85	14.80	19	18	0.31	0.21	34	28.99
Ripening: September 27th	2.95	0.09	0.24	0.13	9.25	17.60	31	31	0.53	0.37	64	41.30

* *note - this sample was not taken from an established field; samples were taken from 1st year planting - planting date June 25th*

Beach Wildrye, *Leymus mollis*

Moisture Free												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	19.01	0.18	2.60	0.13	30.75	58.73	65	63	1.07	0.71	103	96.31
Pre-Boot: June 14th	17.44	0.19	3.19	0.18	32.75	59.99	62	60	1.02	0.67	98	96.04
Boot: June 16th	11.97	0.21	2.92	0.26	35.67	63.47	59	56	0.94	0.61	90	95.56
Anthesis: June 28th	13.57	0.17	2.44	0.18	38.39	65.82	56	53	0.88	0.55	83	95.34
Ripening: August 22nd	9.46	0.10	2.27	0.23	43.70	69.61	50	47	0.76	0.46	73	98.42



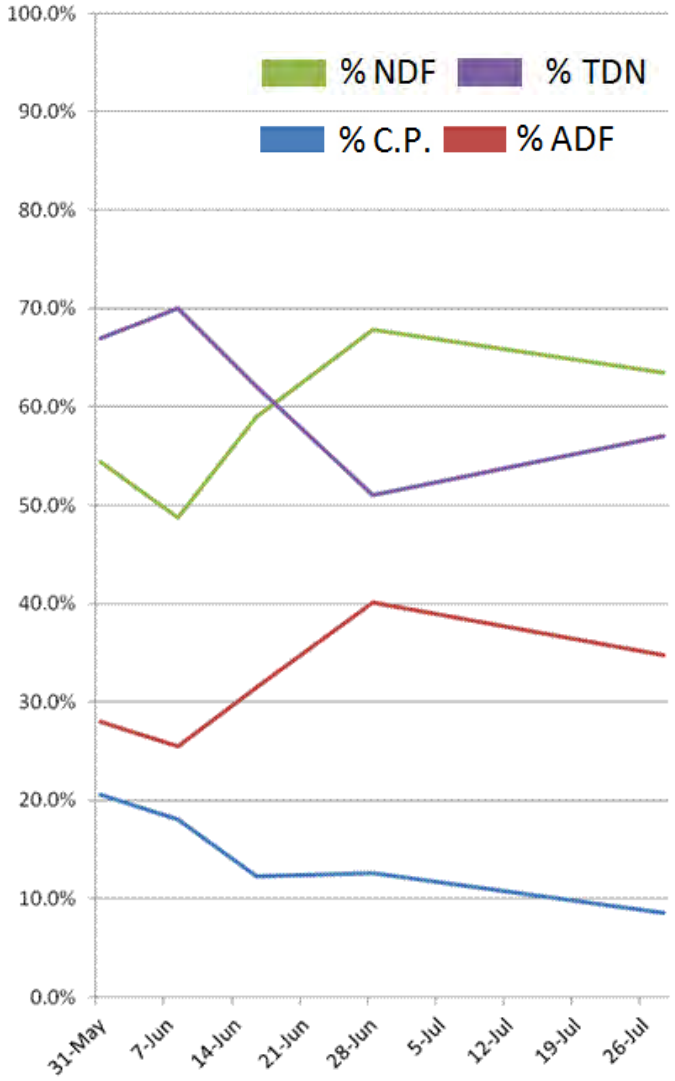


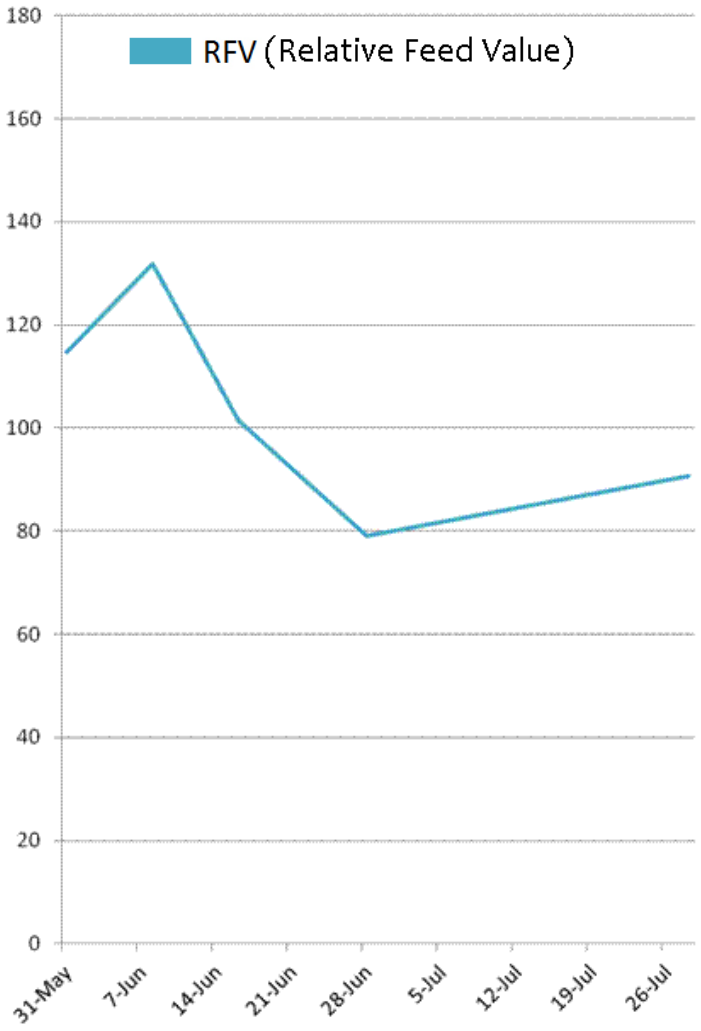
As Fed												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	4.08	0.04	0.56	0.03	6.59	12.59	13.94	13.51	0.23	0.15	22.00	21.44
Pre-Boot: June 14th	3.37	0.04	0.62	0.03	6.33	11.60	11.99	11.60	0.20	0.13	19.01	19.34
Boot: June 16th	2.15	0.04	0.52	0.05	6.41	11.40	10.60	10.06	0.17	0.11	16.09	17.96
Anthesis: June 28th	2.59	0.03	0.47	0.03	7.31	12.54	11.00	10.00	0.17	0.10	16.00	19.05
Ripening: August 22nd	2.72	0.03	0.65	0.07	12.54	19.98	14.00	13.00	0.22	0.13	21.00	28.70

Bering Hairgrass, *Deschampsia beringensis*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	20.62	0.26	2.10	0.33	27.99	54.36	69	67	1.15	0.77	115	95.76
Pre-Boot: June 8th	18.10	0.25	1.93	0.44	25.43	48.72	72	70	1.22	0.83	132	98.40
Boot: June 16th	12.24	0.22	1.93	0.37	31.45	59.04	64	62	1.05	0.70	101	95.54
Anthesis: June 28th	12.64	0.19	1.11	0.37	40.09	67.86	54	51	0.84	0.52	79	95.40
Ripening: July 28th	8.57	0.15	1.45	0.35	34.80	63.42	60	57	0.96	0.62	91	97.74





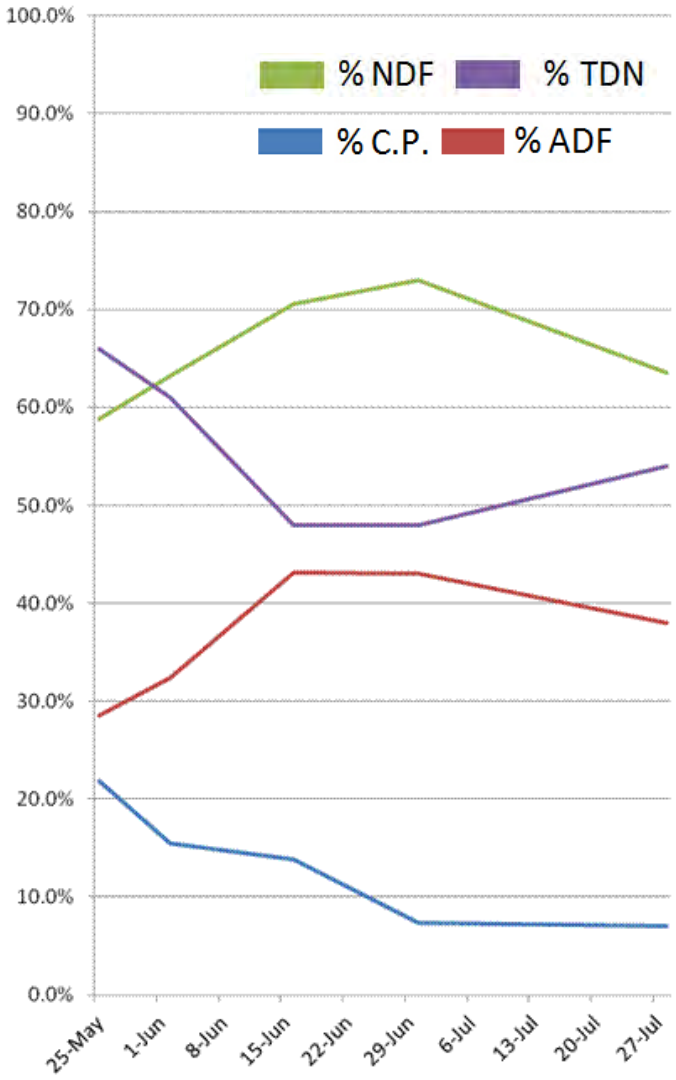
As Fed

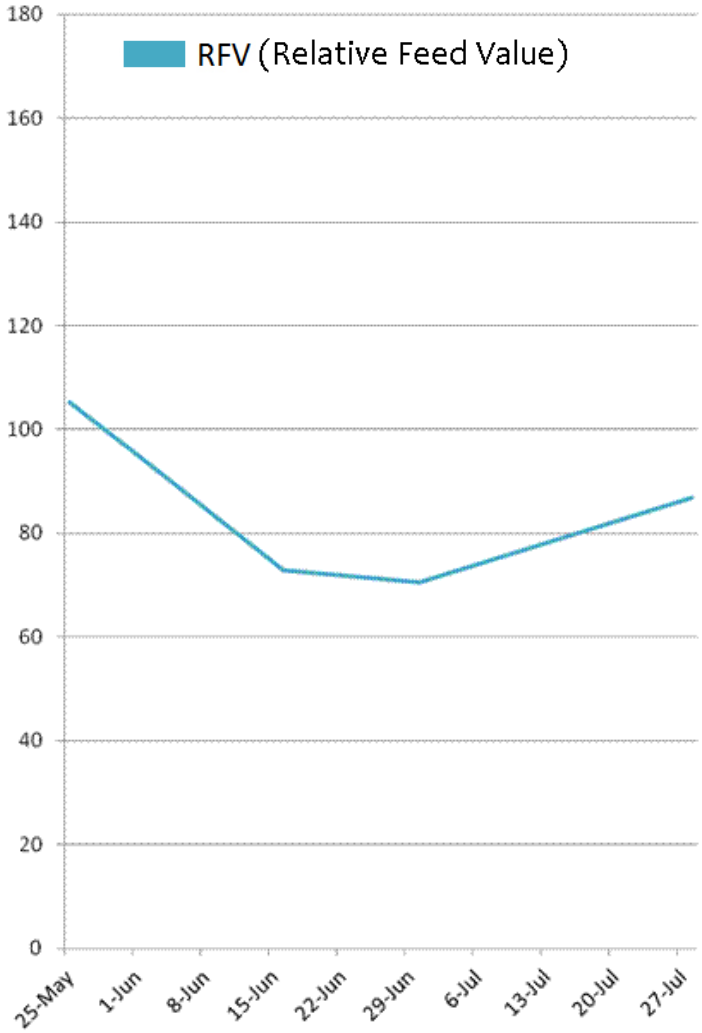
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	4.53	0.06	0.46	0.07	6.16	11.95	15.17	14.73	0.25	0.17	25.00	21.99
Pre-Boot: June 8th	4.15	0.06	0.44	0.10	5.83	11.17	16.50	16.04	0.28	0.19	30.24	22.92
Boot: June 16th	3.00	0.05	0.47	0.09	7.72	14.49	15.71	15.21	0.26	0.17	24.90	24.54
Anthesis: June 28th	3.42	0.05	0.30	0.10	10.84	18.34	15	14	0.23	0.14	21	27.03
Ripening: July 28th	2.67	0.05	0.45	0.11	10.84	19.75	19	18	0.30	0.19	28	31.14

Bluejoint Reedgrass, *Calamagrostis canadensis*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	21.89	0.26	3.11	0.22	28.56	58.85	68	66	1.13	0.76	105	96.51
Pre-Boot: June 2nd	15.45	0.26	2.36	0.22	32.41	63.18	63	61	1.03	0.68	94	96.28
Boot: June 16th	13.79	0.16	1.79	0.14	43.14	70.57	51	48	0.77	0.47	73	96.05
Anthesis: June 30th	7.39	0.13	1.12	0.14	43.04	72.94	51	48	0.78	0.47	71	95.58
Ripening: July 28th	7.08	0.15	0.77	0.27	37.98	63.51	56	54	0.89	0.56	87	98.06



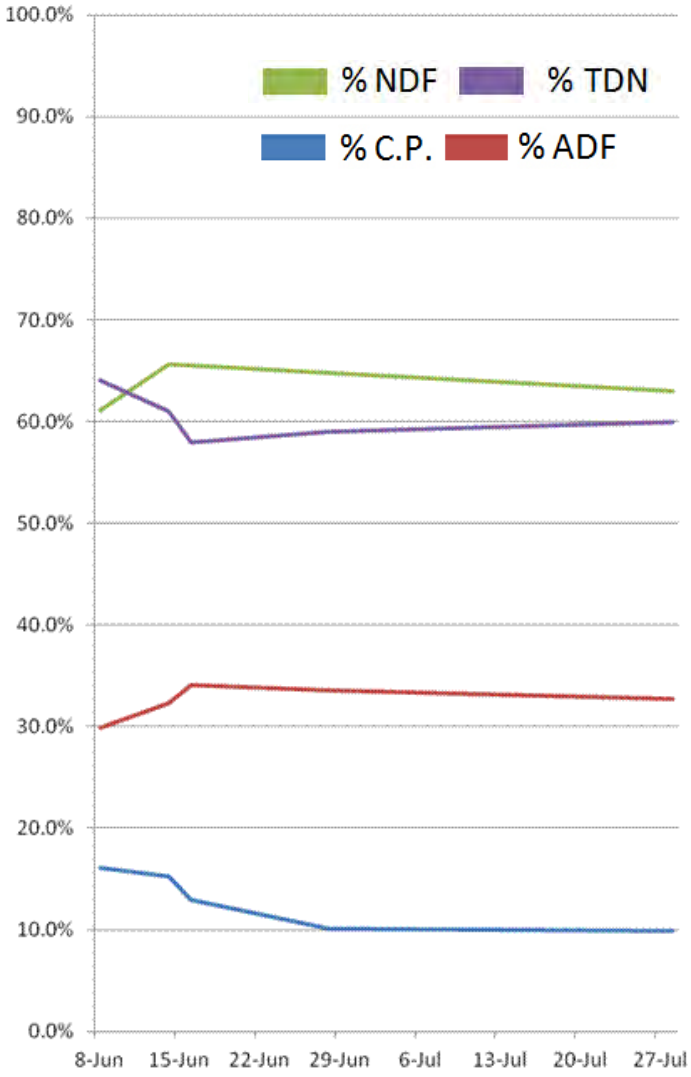


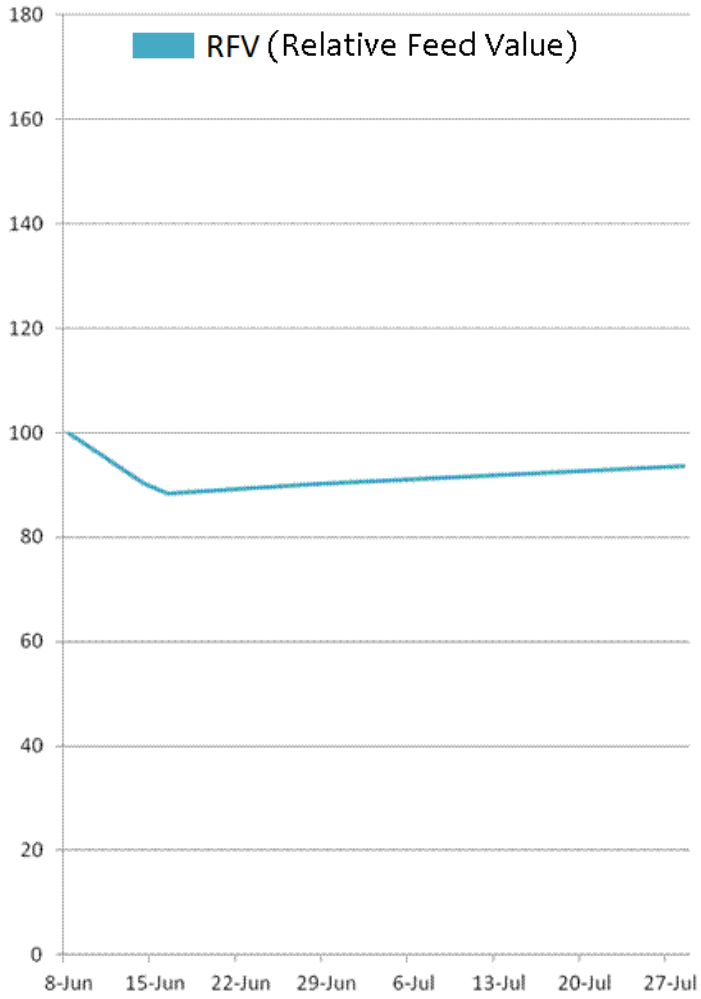
As Fed

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	4.11	0.05	0.58	0.04	5.37	11.06	12.78	12.40	0.21	0.14	20.00	18.79
Pre-Boot: June 2nd	3.04	0.05	0.46	0.04	6.38	12.43	12.39	12.00	0.20	0.13	18.00	19.67
Boot: June 16th	3.66	0.04	0.47	0.04	11.44	18.71	13.52	12.72	0.20	0.12	19.32	27.51
Anthesis: June 30th	2.03	0.03	0.31	0.04	11.81	20.01	14	13	0.21	0.13	19	27.43
Ripening: July 28th	3.14	0.07	0.34	0.12	16.85	28.17	25	24	0.39	0.25	39	44.36

Kentucky Bluegrass, *Poa pratensis*

Moisture Free												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: June 8th	16.13	0.30	2.29	0.39	29.91	61.06	66	64	1.09	0.73	100	98.43
Pre-Boot: June 14th	15.29	0.25	2.17	0.36	32.33	65.64	63	61	1.03	0.68	90	95.70
Boot: June 16th	12.93	0.24	2.04	0.35	34.10	65.56	61	58	0.98	0.64	88	95.21
Anthesis: June 28th	10.17	0.20	1.26	0.40	33.58	64.77	61	59	0.99	0.65	90	95.30
Ripening: July 28th	9.95	0.20	1.60	0.64	32.76	63.03	62	60	1.02	0.67	94	98.01



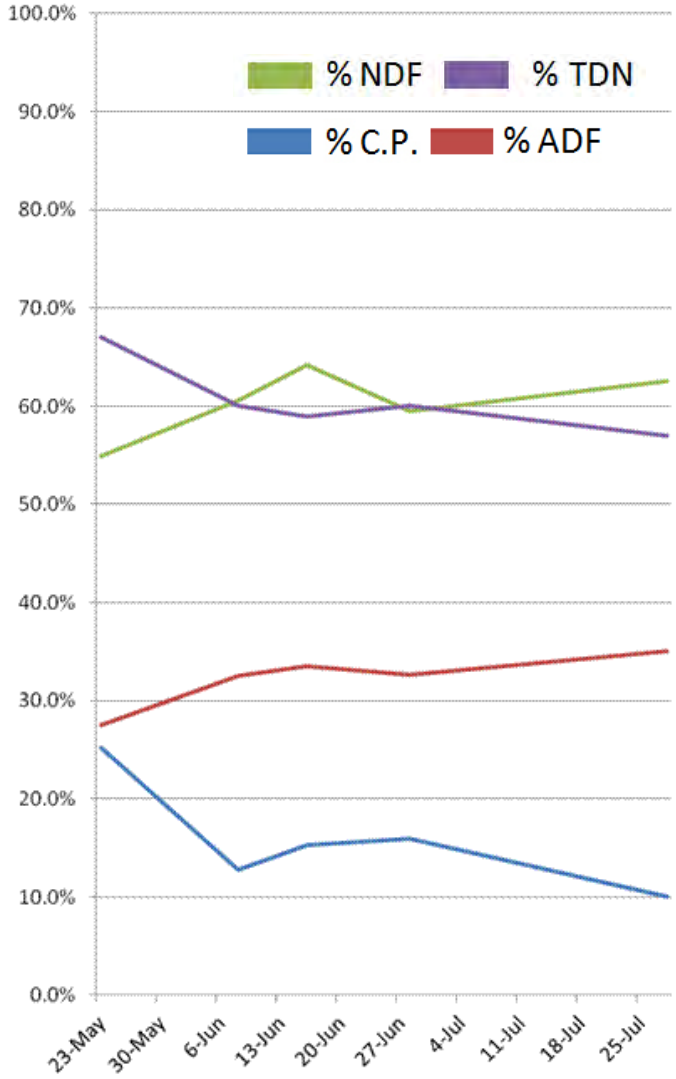


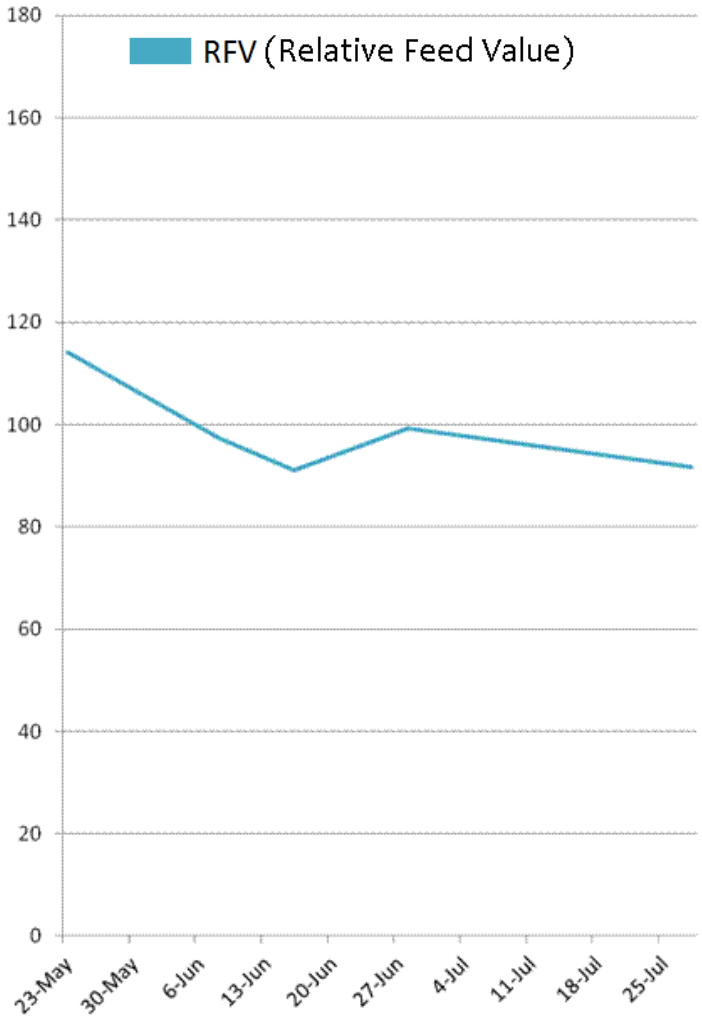
As Fed												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: June 8th	4.09	0.08	0.58	0.10	7.59	15.48	16.74	16.23	0.28	0.19	25.34	25.36
Pre-Boot: June 14th	3.46	0.06	0.49	0.08	7.31	14.85	14.25	13.80	0.23	0.15	20.42	22.62
Boot: June 16th	3.70	0.07	0.58	0.10	9.77	18.78	17.47	16.61	0.28	0.18	25.33	28.64
Anthesis: June 28th	3.87	0.08	0.48	0.15	12.78	24.66	23.00	22.00	0.38	0.25	34.00	38.07
Ripening: July 28th	3.81	0.08	0.61	0.25	12.55	24.15	24.00	23.00	0.39	0.26	36.00	38.32

Polargrass, *Arctagrostis latifolia*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 23rd	25.21	0.32	3.13	0.45	27.52	54.94	69	67	1.16	0.78	114	95.7
Pre-Boot: June 8th	12.74	0.26	2.61	0.36	32.57	60.64	63	60	1.02	0.67	97	98.57
Boot: June 16th	15.23	0.29	2.87	0.48	33.53	64.17	61	59	1.00	0.65	91	95.59
Anthesis: June 28th	15.96	0.26	1.81	0.43	32.63	59.54	63	60	1.02	0.67	99	95.55
Ripening: July 28th	10.02	0.20	1.77	0.47	35.02	62.57	60	57	0.96	0.62	92	97.91



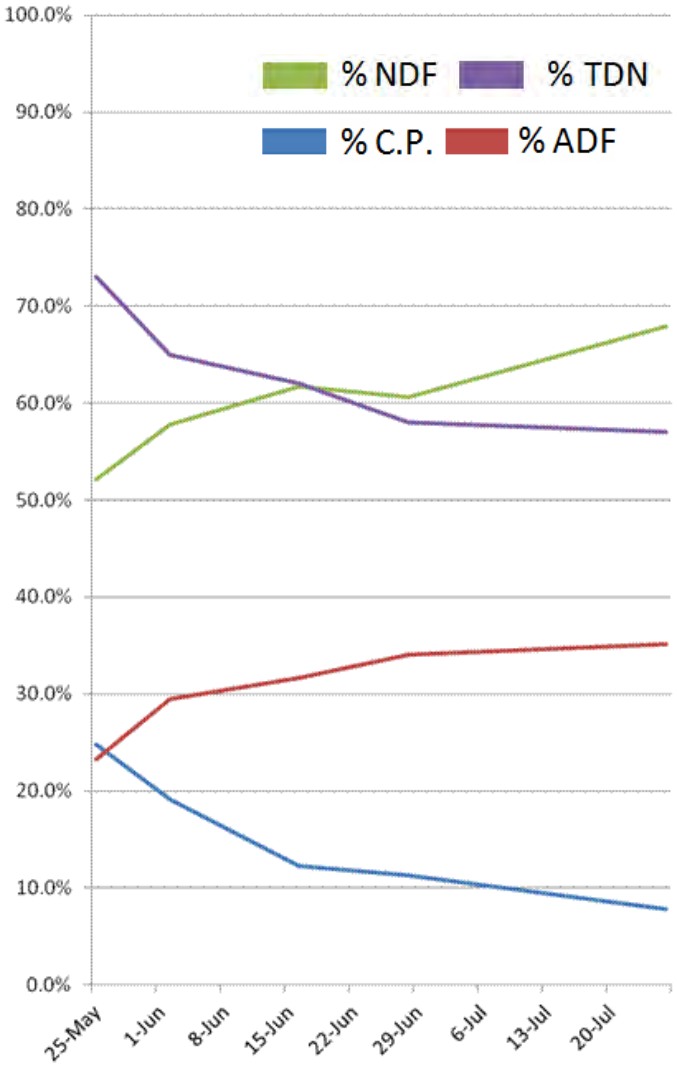


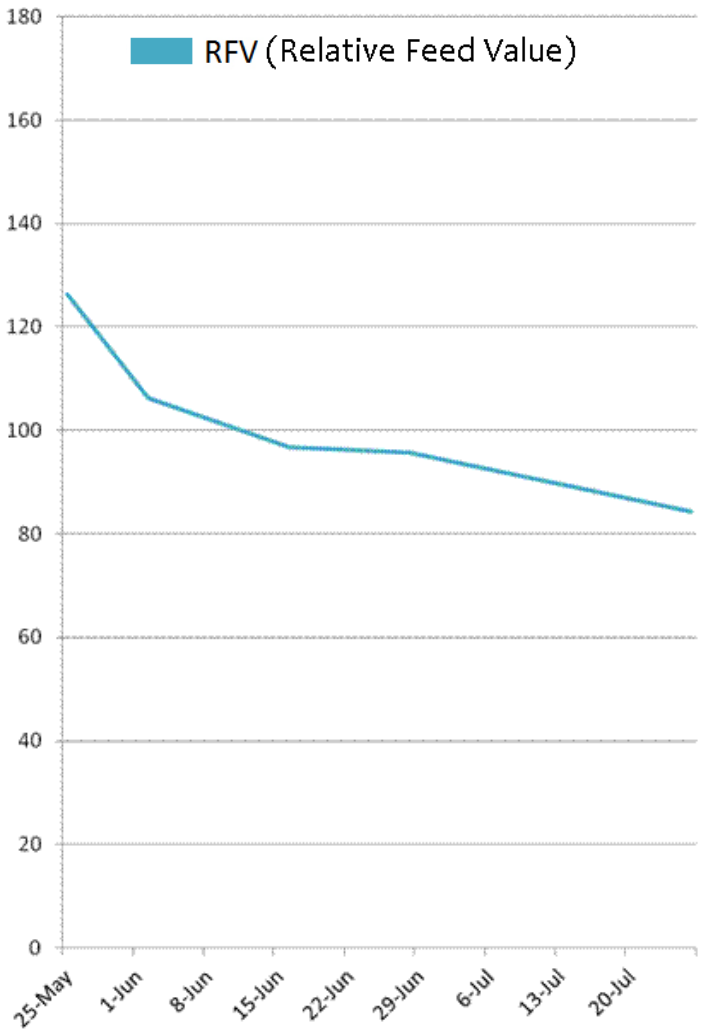
As Fed

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 23rd	4.25	0.05	0.53	0.08	4.64	19.26	11.63	11.29	0.20	0.13	19.00	16.85
Pre-Boot: June 8th	2.59	0.05	0.53	0.07	6.61	12.30	12.78	12.17	0.21	0.14	19.77	20.29
Boot: June 16th	3.20	0.06	0.60	0.10	7.04	13.48	12.81	12.39	0.21	0.14	19.11	21.00
Anthesis: June 28th	3.64	0.06	0.41	0.10	7.45	13.59	14	14	0.23	0.15	23	22.82
Ripening: July 28th	2.80	0.06	0.49	0.13	9.79	17.49	17	16	0.27	0.17	26	27.96

Red Fescue, *Festuca rubra*

Moisture Free												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	24.77	0.31	3.00	0.32	23.32	52.08	74	73	1.27	0.87	126	97.19
Pre-Boot: June 2nd	19.12	0.35	2.51	0.41	29.49	57.74	67	65	1.11	0.74	106	96.12
Boot: June 16th	12.32	0.28	2.75	0.35	31.60	61.74	64	62	1.05	0.69	97	95.86
Anthesis: June 28th	11.33	0.25	1.74	0.47	34.02	60.61	61	58	0.98	0.64	96	95.96
Ripening: July 26th	7.81	0.17	1.36	0.50	35.14	67.95	59	57	0.95	0.62	84	97.76

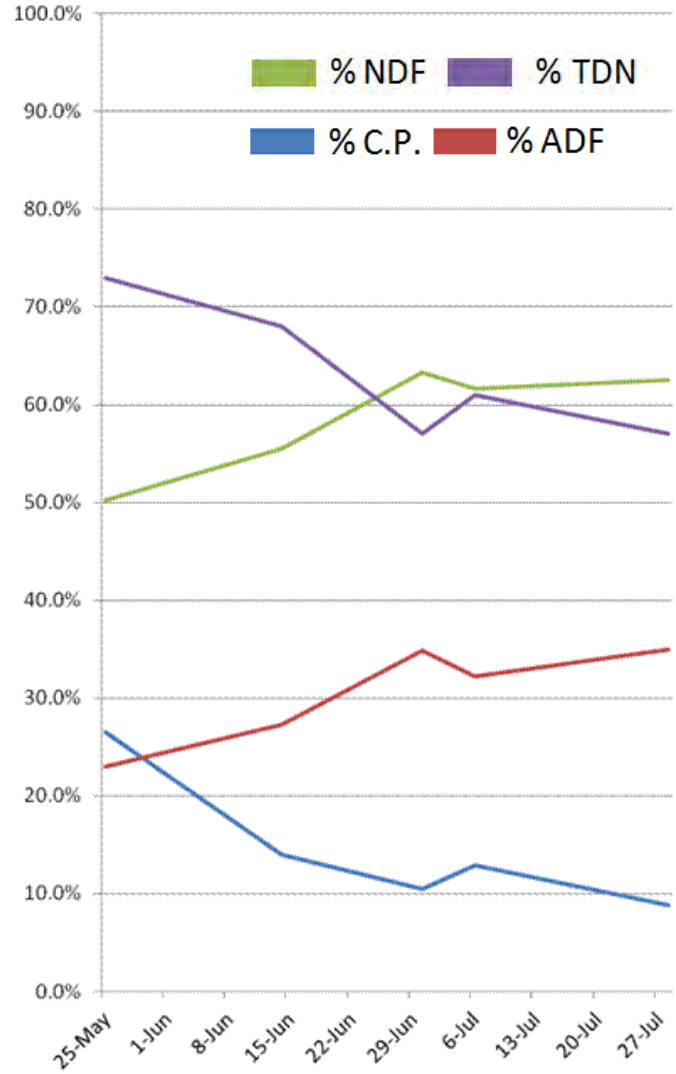


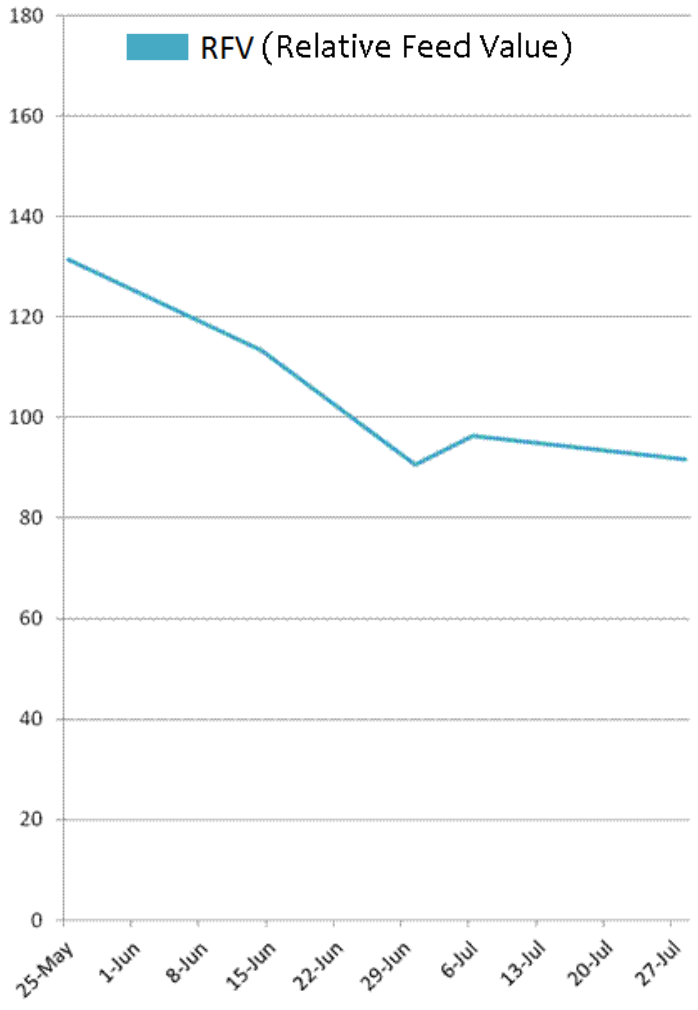


As Fed												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	5.40	0.07	0.65	0.07	5.08	11.35	16.13	15.91	0.28	0.19	28.00	21.80
Pre-Boot: June 2nd	3.97	0.07	0.52	0.09	6.12	11.98	13.90	13.49	0.23	0.15	22.00	20.75
Boot: June 16th	3.16	0.07	0.71	0.09	8.10	15.82	16.40	15.88	0.27	0.18	24.81	25.62
Anthesis: June 28th	3.24	0.07	0.50	0.13	9.73	17.34	17.00	17.00	0.28	0.18	27.00	28.61
Ripening: July 26th	2.79	0.06	0.49	0.18	12.57	24.31	21.00	20.00	0.34	0.22	30.00	35.77

Siberian Wildrye, *Elymus sibiricus*

Moisture Free												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	26.48	0.26	2.97	0.35	22.95	50.23	75	73	1.28	0.88	132	97.03
Pre-Boot: June 14th	13.99	0.21	2.09	0.32	27.23	55.55	70	68	1.17	0.79	113	95.16
Boot: June 30th	10.43	0.15	1.39	0.26	34.85	63.34	60	57	0.96	0.62	91	95.27
Anthesis: July 6th	12.86	0.16	1.33	0.35	32.17	61.60	63	61	1.03	0.68	96	98.19
Ripening: July 28th	8.87	0.15	1.01	0.33	34.94	62.58	60	57	0.96	0.62	92	97.95



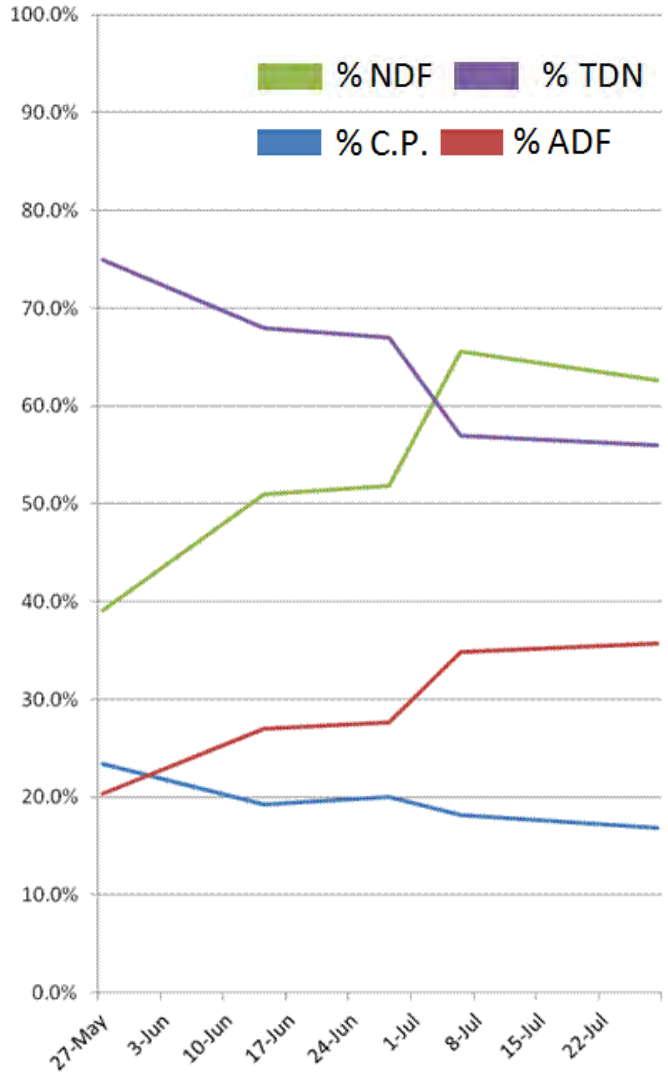


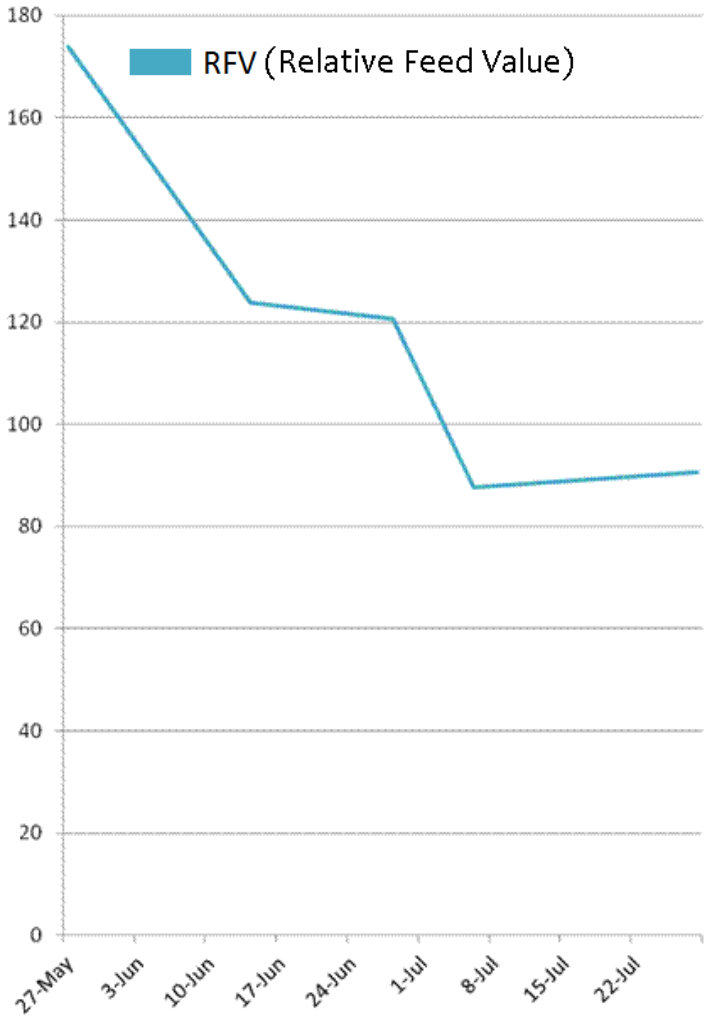
As Fed												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	5.67	0.06	0.64	0.08	4.92	10.76	16.07	15.64	0.27	0.19	28.00	21.43
Pre-Boot: June 14th	3.49	0.05	0.52	0.08	6.80	13.88	17.49	16.99	0.29	0.20	28.31	24.98
Boot: June 30th	2.65	0.04	0.35	0.07	8.85	16.08	15	14	0.24	0.16	23	25.39
Anthesis: July 6th	4.63	0.06	0.48	0.13	11.58	22.18	23	22	0.37	0.24	35	36.01
Ripening: July 28th	3.92	0.07	0.45	0.15	15.43	27.64	27	25	0.42	0.27	40	44.17

Slender Wheatgrass, *Elymus trachycaulus*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	23.43	0.23	2.67	0.34	20.36	39.09	77	75	1.32	0.91	174	96.04
Pre-Boot: June 14th	19.30	0.24	2.95	0.31	27.00	50.99	70	68	1.18	0.80	124	95.84
Boot: June 28th	20.02	0.25	2.03	0.48	27.69	51.87	69	67	1.16	0.78	121	95.20
Anthesis: July 6th	18.20	0.22	2.13	0.39	34.82	65.57	60	57	0.96	0.62	88	98.20
Ripening: July 28th	16.81	0.24	1.89	0.49	35.73	62.64	59	56	0.94	0.61	91	97.82





As Fed

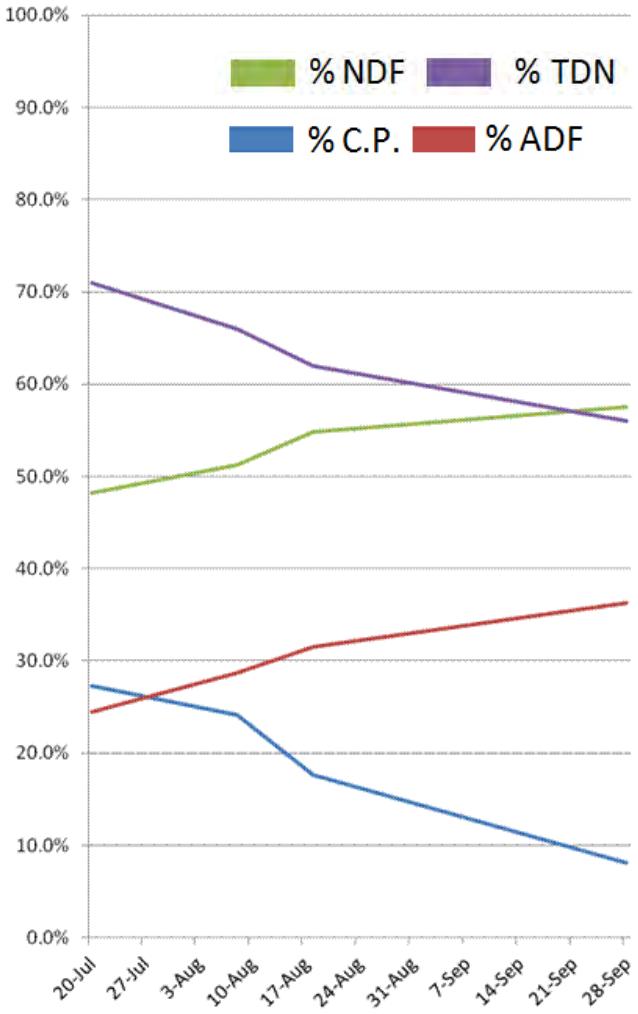
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	5.45	0.05	0.62	0.08	4.73	9.08	17.89	17.43	0.31	0.21	40.00	23.24
Pre-Boot: June 14th	4.28	0.05	0.65	0.07	5.99	11.30	15.52	15.08	0.26	0.18	27.45	22.17
Boot: June 28th	4.95	0.06	0.50	0.12	6.85	12.83	17.00	17.00	0.29	0.19	30.00	24.73
Anthesis: July 6th	4.41	0.05	0.52	0.09	8.44	15.89	15.00	14.00	0.23	0.15	21.00	24.24
Ripening: July 28th	5.53	0.08	0.62	0.16	11.75	20.26	19.00	18.00	0.31	0.20	30.00	32.89

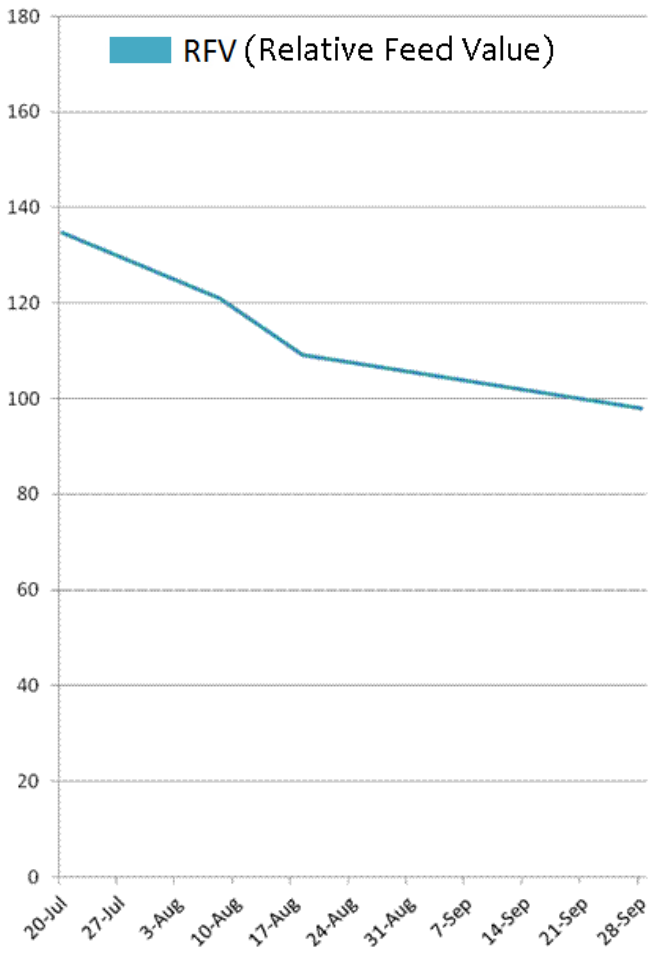
Smooth Brome, *Bromus inermis*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 20th	27.33	0.39	3.51	0.33	24.46	48.24	73	71	1.24	0.85	135	97.44
Pre-Boot: August 8th	24.17	0.38	2.19	0.43	28.67	51.2	68	66	1.13	0.76	121	96.73
Boot: August 18th	17.67	0.31	2.36	0.38	31.53	54.82	64	62	1.05	0.69	109	97.97
Anthesis: September 28th	8.12	0.14	0.81	0.20	36.30	57.58	58	56	0.93	0.59	98	97.81

** note - sample was not taken from the PMC, instead came from established nearby hayfield. Samples were collected after 1st hay cutting was harvested*





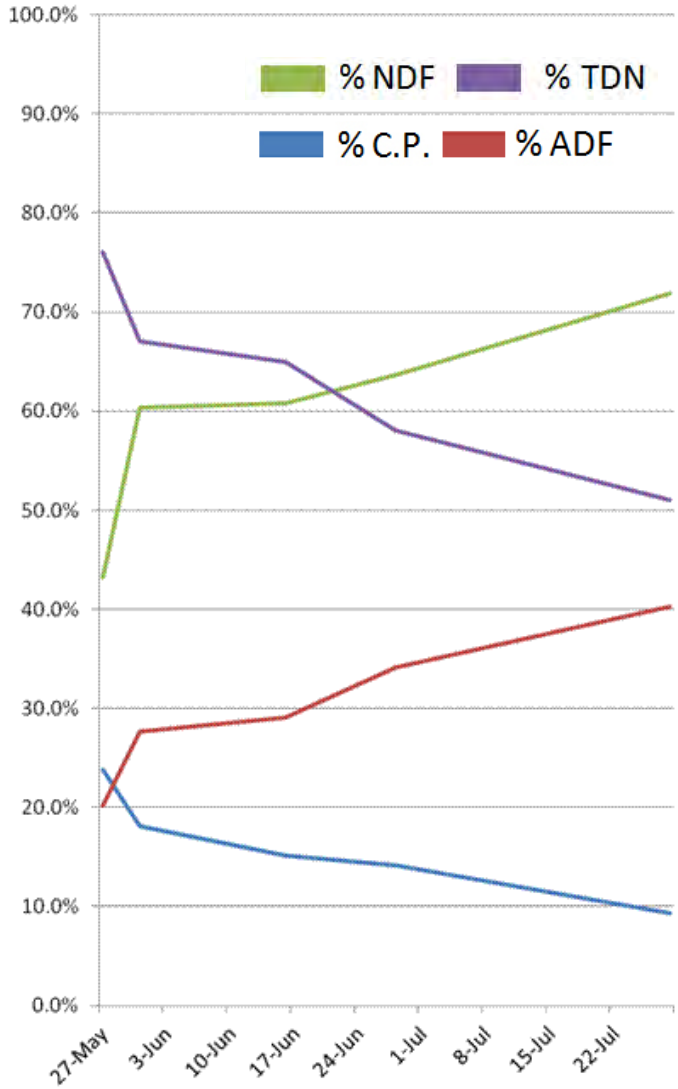
As Fed

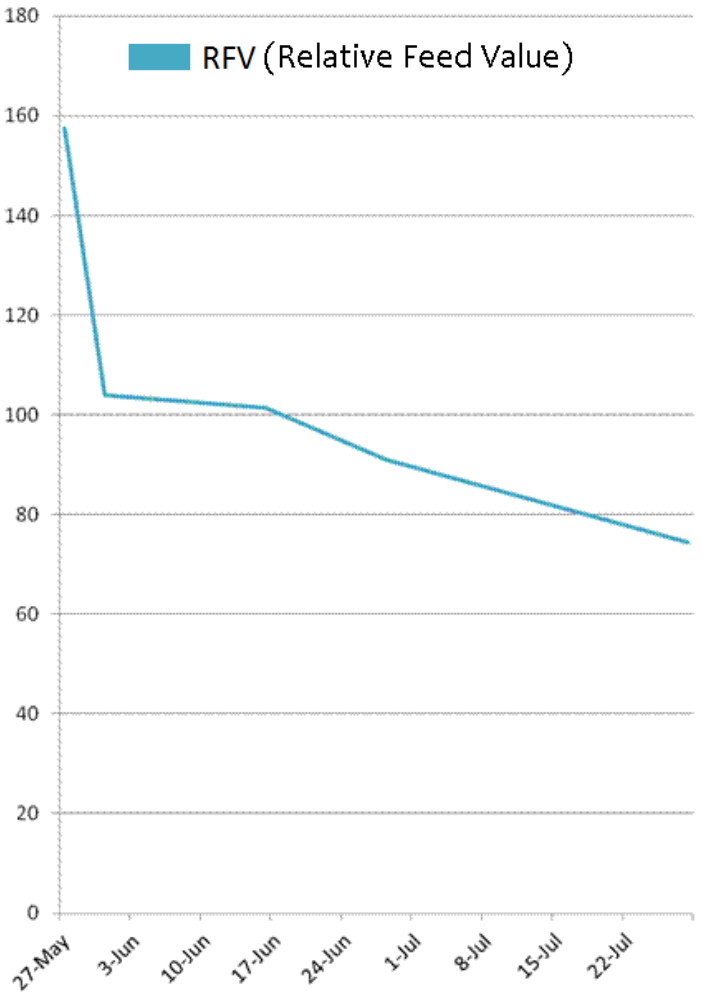
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 20th	4.91	0.07	0.63	0.06	4.39	8.66	13.00	13.00	0.22	0.15	24.00	17.95
Pre-Boot: August 8th	3.74	0.06	0.34	0.07	4.43	7.92	11.00	10.00	0.17	0.12	19.00	15.46
Boot: August 18th	3.41	0.06	0.46	0.07	6.09	10.59	12.00	12.00	0.20	0.13	21.00	19.31
Anthesis: September 28th	2.84	0.05	0.28	0.07	12.68	20.12	20.00	20.00	0.32	0.21	34.00	34.94

** note - sample was not taken from the PMC, instead came from established nearby hayfield. Samples were collected after 1st hay cutting was harvested*

Spike Trisetum, *Trisetum spicatum*

Moisture Free												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	23.86	0.22	1.81	0.33	20.19	43.24	77	76	1.32	0.92	157	96.13
Pre-Boot: May 31st	18.12	0.27	1.94	0.28	27.64	60.34	69	67	1.16	0.78	104	95.89
Boot: June 16th	15.17	0.22	1.72	0.24	29.07	60.75	67	65	1.12	0.75	101	95.58
Anthesis: June 28th	14.15	0.21	1.39	0.29	34.17	63.65	61	58	0.98	0.64	91	95.44
Ripening: July 28th	9.32	0.19	1.21	0.40	40.25	71.91	54	51	0.84	0.52	74	97.93





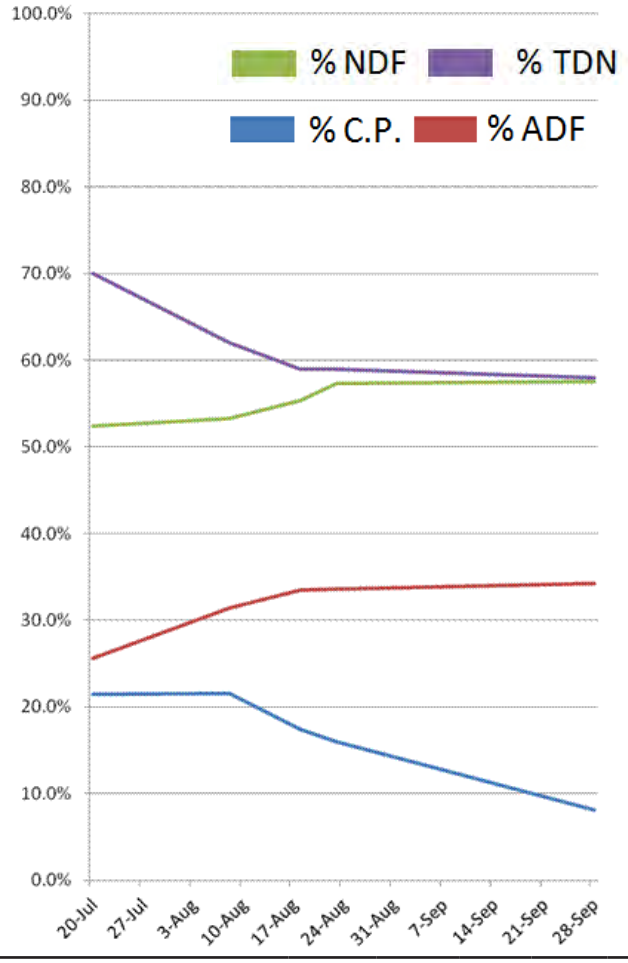
As Fed												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	5.81	0.05	0.04	0.08	4.92	10.53	18.75	18.51	0.32	0.22	38.00	24.35
Pre-Boot: May 31st	4.38	0.07	0.47	0.07	6.68	14.59	16.68	16.20	0.28	0.19	25.00	24.18
Boot: June 16th	4.91	0.07	0.56	0.08	9.41	19.67	21.69	21.05	0.36	0.24	32.85	32.38
Anthesis: June 28th	4.85	0.07	0.48	0.10	11.71	21.81	21.00	20.00	0.34	0.22	31.00	34.27
Ripening: July 28th	4.33	0.09	0.56	0.19	18.70	33.40	25.00	24.00	0.39	0.24	35.00	46.45

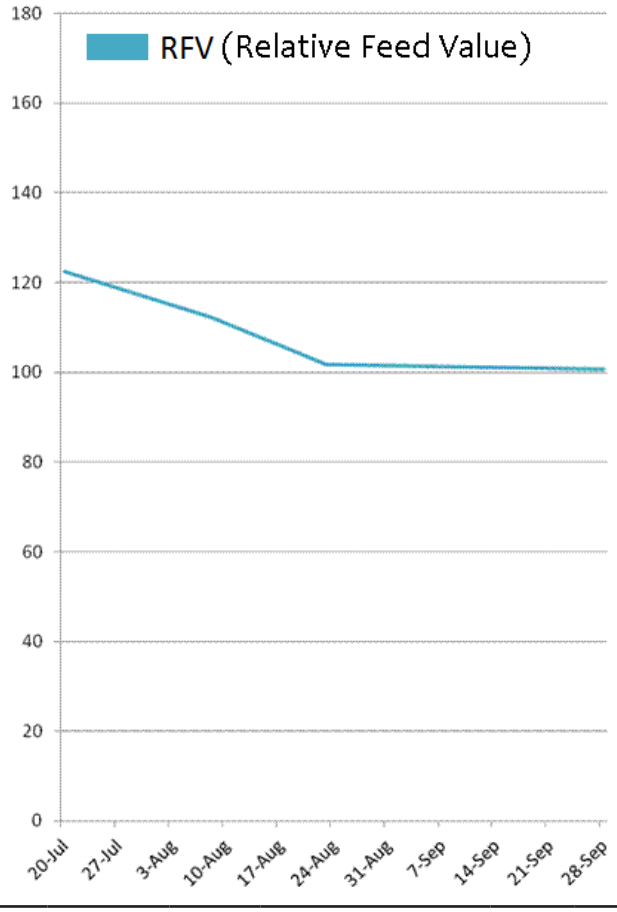
Timothy, *Phleum pratense*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 20th	21.43	0.35	3.09	0.29	25.61	52.39	72	70	1.21	0.83	122	97.41
Pre-Boot: August 8th	21.53	0.34	2.63	0.37	31.42	53.33	64	62	1.05	0.70	112	97.00
Boot: August 18th	17.42	0.27	2.05	0.27	33.53	55.41	61	59	1.00	0.65	105	97.96
Anthesis: August 23rd	15.95	0.26	1.71	0.34	33.57	57.38	61	59	0.99	0.65	102	98.01
Ripening: September 28th	8.12	0.15	1.01	0.11	34.20	57.58	61	58	0.98	0.64	101	97.73

** note - sample was not taken from the PMC, instead came from established nearby hayfield. Samples were collected after 1st hay cutting was harvested*





As Fed

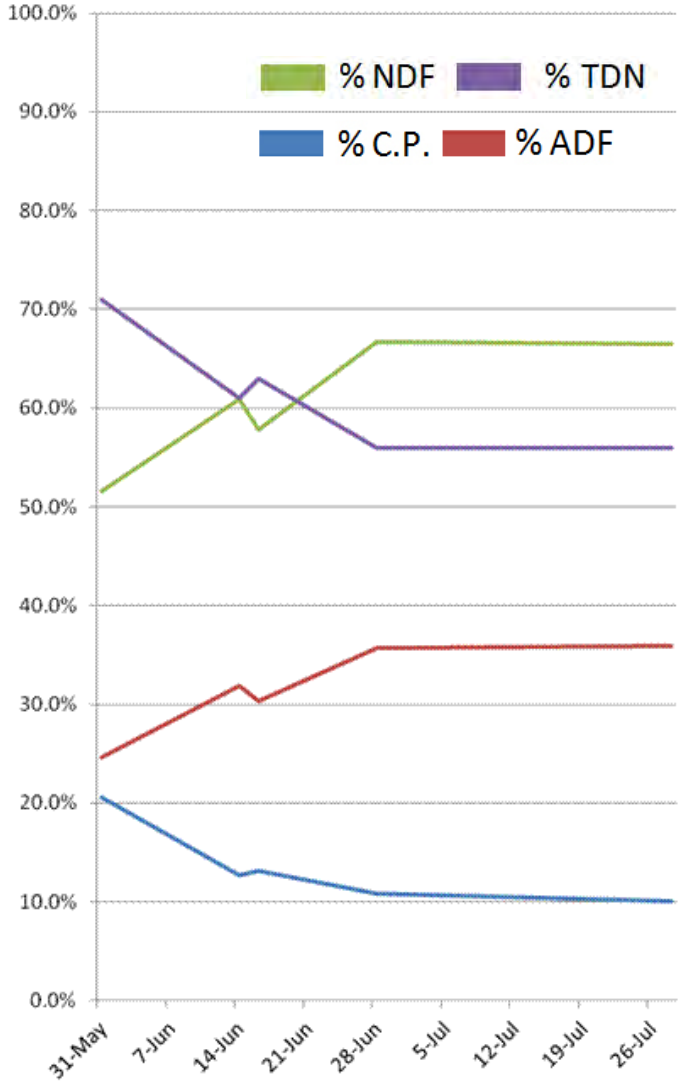
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 20th	4.02	0.07	0.58	0.05	4.80	9.82	13.00	13.00	0.23	0.16	23.00	16.74
Pre-Boot: August 8th	3.43	0.05	0.42	0.06	5.01	8.50	10.00	10.00	0.17	0.11	18.00	15.94
Boot: August 18th	3.71	0.06	0.44	0.06	7.14	11.8	13	13	0.21	0.14	22	21.3
Anthesis: August 23rd	3.24	0.05	0.35	0.07	6.82	11.66	12.00	12	0.20	0.13	21.00	20.32
Ripening: September 28th	2.51	0.05	0.31	0.03	10.56	17.78	19	18	0.3	0.2	31	30.88

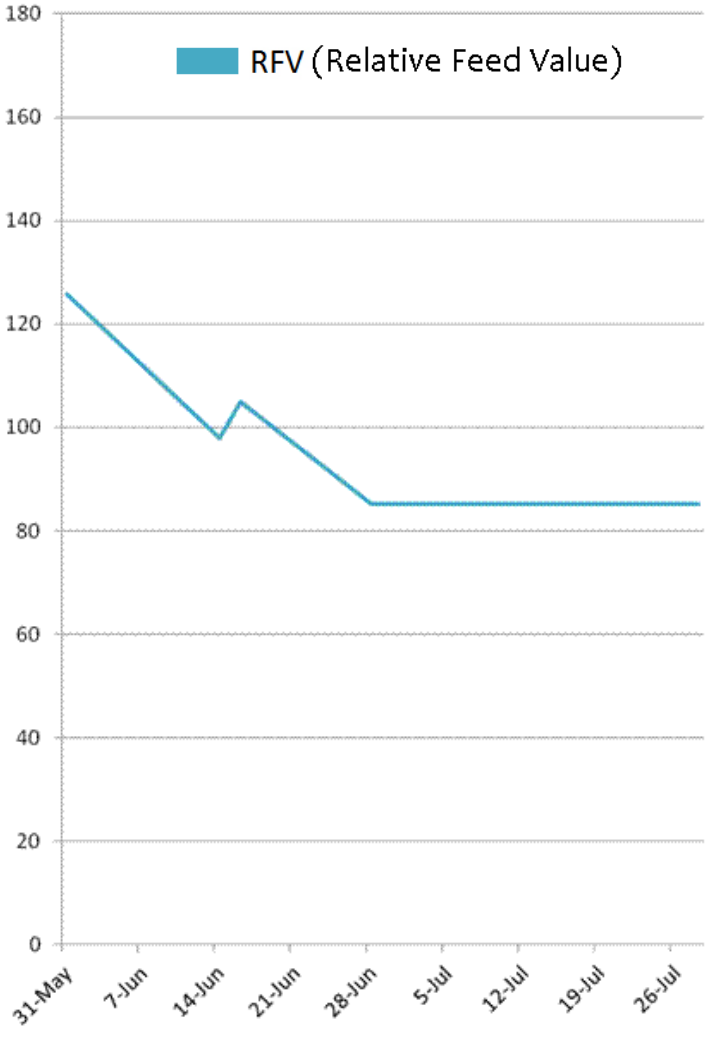
** note - sample was not taken from the PMC, instead came from established nearby hayfield. Samples were collected after 1st hay cutting was harvested*

Tufted Hairgrass, *Deschampsia cespitosa*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	20.54	0.27	2.07	0.34	24.64	51.59	73	71	1.24	0.85	126	95.85
Pre-Boot: June 14th	12.67	0.27	2.15	0.34	31.87	60.86	64	61	1.04	0.69	98	95.73
Boot: June 16th	13.11	0.31	2.79	0.40	30.38	57.84	66	63	1.08	0.72	105	95.84
Anthesis: June 28th	10.89	0.26	1.63	0.30	35.69	66.71	59	56	0.94	0.61	85	95.28
Ripening: July 28th	10.09	0.18	1.42	0.46	35.95	66.50	59	56	0.93	0.60	85	97.95





As Fed

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	5.18	0.07	0.52	0.09	6.22	13.02	18.42	17.91	0.31	0.21	32.00	25.23
Pre-Boot: June 14th	2.71	0.06	0.46	0.07	6.83	13.04	13.71	13.07	0.22	0.15	20.98	21.42
Boot: June 16th	3.26	0.08	0.69	0.10	7.55	14.38	16.41	15.66	0.27	0.18	26.08	24.86
Anthesis: June 28th	3.32	0.08	0.50	0.09	10.89	20.35	18	17	0.29	0.19	26	30.50
Ripening: July 28th	3.57	0.06	0.5	0.16	12.71	23.51	21	20	0.33	0.21	30	35.35

Appendix B: Seed Specifications / Certification

Seed Specifications

Quality seed is critical to success. Specifying "certified" seed assures quality because the seed must meet certain standards for germination and purity; certification also provides some assurance of genetic quality.

Alaska Certified seed tags

Some native seed species are not available as certified seed. Seed quality can still be ascertained by examining percent germination and percent purity; information that will be clearly labeled for any seed sold in Alaska. This labeling is required by 11 AAC, chapter 34: Seed Regulations.

The true cost of seed can be determined by the Pure Live Seed calculation. To calculate Pure Live Seed (PLS), use the equation:

$$PLS = \left[\frac{\text{Germination \%} \quad x \quad \text{Purity \%}}{100} \right]$$

The true price of seed, then, can be determined using the equation:

$$\text{Price}_{PLS} = \left[\frac{\text{Bulk cost of seed / lb} \quad x \quad 100}{PLS} \right]$$

These calculations can increase the accuracy of bid comparisons. PLS price is a good method of comparing different seed lots at time of purchase. All seed sold or used in the state of Alaska must also be free of noxious weeds, under **11 AAC 34.075**. This is noted on seed tags, along with germination and purity.

Seeding Rates

When determining seeding rates, divide the desired seeding rate by the percent germination of the seed being used. For example, to achieve a 10 lbs/ acre seeding rate with seed having an 80% PLS (determined using the equation above), 10 lbs / .80 indicates that 12.5 lbs / acre should be used. If problems occur or questions arise regarding seed, call the Alaska Plant Materials Center at (907) 745-4469.

Seed stored on site should be kept cool, dry, and in rodent-free areas. Remember seed is a living commodity. A bag may contain seed; however some percentage may be dead husks - the equivalent of cadavers. Always buy seed based on the PLS Calculation.

Certified Seed

The term "certified seed" can be used in two different situations. The official use of the term Certified seed (with a capital C) is to describe seed that has been grown under the rules of the Seed Certification Program. Certified seed is the usual commercial category of seed. Its ancestry can be traced back to Registered Class or Foundation Class seed. In addition, Certified seed must meet various standards of purity and germination. These standards are a means of verifying authenticity of a seed source. All Alaska developed seed varieties or cultivars can be sold as either Certified or common.

Seed can also be certified (without a capital C) to be free of weeds or as meeting a minimum germination standard (**11 AAC 34.075**). This has nothing to do with variety identification — it simply indicates the quality of the seed. In other words, the buyer knows quality, but has no assurance of type (other than species).

Certified seed should be used when available. Seed produced in Alaska is easy to trace to its origin. It may be classified as common (uncertified) 'Arctared', but it is still 'Arctared'. Minimum purities and germination should always be stated with orders. Common seed is a usable product and may be used to meet demands. Common seed should meet Certified standards with regard to germination and purity, although these standards may need to be relaxed to acquire sufficient material for a large job. Lower germination rates can be overcome by increasing the seeding rate. Lower purities, however, should be avoided, as weeds can become a problem.

Pre-certified class seed tags

Other Certification Classes

When purchasing seed, a buyer should be aware of the differences between certification classes. Many new sources of native seed are being developed in Alaska. Generally, these will not be sold as Certified seed. They may carry the following designations: 'Source Identified', 'Tested', or 'Selected'. These classes will be consistent with the certification standards of germination and purity, however the term 'Certified seed' will not apply. These classes are called 'Pre-certified' classes.

Appendix C: Prohibited & Restricted Noxious Weeds

(A) The following are prohibited noxious weeds:

Photo: Steve Dewey, Utah State University | Bugwood.org

Field bindweed (*Convolvulus arvensis*)

Photo: Elizabeth Bella, USDA Forest Service | Bugwood.org

Austrian fieldcress (*Rorippa austriaca*)

Photo: John D. Byrd, Mississippi State University | Bugwood.org

Galensoga (*Galensoga parviflora*)

Photo: Tom Huette, USDA Forest Service | Bugwood.org

Hempnettle (*Galeopsis tetrahit*)

Photo: Ted Bodner, Southern Weed Science Society | Bugwood.org

Horsenettle (*Solanum carolinense*)

Photo: Steve Dewey, Utah State University | Bugwood.org

Russian Knapweed (*Acroptilon repens*)

Photo: Mary Ellen Harte | Bugwood.org

Blue-flowering lettuce (*Lactuca pulchella*)

Photo: Steve Dewey, Utah State University | Bugwood.org

Quackgrass (*Elymus repens*)

Photo: Michael Rasy, University of Alaska | Bugwood.org

Perennial sowthistle (*Sonchus arvensis*)

Photo: William M. Ciesla, Forest Health Mgmt. Intl. | Bugwood.org

Leafy spurge (*Euphorbia esula*)

Photo: Steve Dewey, Utah State University | Bugwood.org

Canada thistle (*Cirsium arvense*)

Photo: Mary Ellen Harte | Bugwood.org

Whitetops and its varieties (*Cardaria draba, C. pubescens, Lapidium latifolium*)

Photo: John D. Byrd, Mississippi State University | Bugwood.org

Purple loosestrife (*Lythrum salicaria*)

Photo: Michael Shephard, USDA Forest Service | Bugwood.org

Orange hawkweed (*Hieracium aurantiacum*)

Statutory Authority:
AS 03.05 010
AS 03.05.030
AS 44.37.030
11AAC 34.020

This list is available online, at:
http://dnr.alaska.gov/ag/akpmc/invasives/pdf/noxious-weeds.pdf

(B) The following are restricted noxious weeds, with their maximum allowable tolerances:

Photo: Steve Dewey, Utah State University | Bugwood.org

Annual bluegrass (*Poa annua*), 90 seeds per pound

Photo: Elena Rostunova

Blue burr (*Lappula echinata*), 18 seeds per pound

Photo: Joseph M. DiTomaso, University of California Davis | Bugwood.org

Mustard (*Brassica juncea, Sinapis arvensis*), 36 seeds per pound

Photo: Steve Dewey, Utah State University | Bugwood.org

Wild oats (*Avena fatua*), seven seeds per pound

Photo: Chris Evans, River to River CWMA | Bugwood.org

Buckhorn plantain (*Plantago sp.*), 90 seeds per pound

Photo: Joseph M. DiTomaso, University of California Davis | Bugwood.org

Radish (*Raphanus raphanistrum*), 27 seeds per pound

Photo: Michael Shephard, USDA Forest Service | Bugwood.org

Yellow toadflax (*Linaria vulgaris*), one seed per pound

Photo: Michael Rasy, University of Alaska | Bugwood.org

Tufted vetch (*Vicia cracca*), two seeds per pound

Photo: Richard Old, XID Services Inc. | Bugwood.org

Wild buckwheat (*Polygonum convolvulus*), two seeds per pound

Statutory Authority:
AS 03.05 010
AS 03.05.030
AS 44.37.030
11AAC 34.020
(In effect before 7/28/59; am 3/2/78, Reg. 65; am 10/28/83, Reg. 88)

This list is available online, at:
http://dnr.alaska.gov/ag/akpmc/invasives/pdf/noxious-weeds.pdf

Glossary

Photo: James McCormick

Round bale of Smooth Brome and Timothy hay

Bunch grass growing in coarse textured soil

Sod grass farm near Palmer, Alaska

Term	Definition
Acid Detergent Fiber (ADF):	The indigestible portion of a forage sample. It is measured much like NDF except that a forage sample is boiled in an acidic detergent. The boiling removes sugars, fats, starches, proteins, and hemicellulose. The amount of ADF residue is inversely related to energy so high quality forages have low amounts of ADF.
Age Class:	A descriptive term to indicate the relative age of plants.
Agronomy:	The application of soil and plant sciences to soil management and crop production.
Allelopathy:	Chemical inhibition of one plant by another.
Amino Acids:	Amino groups with at least one carboxyl group, linked together in a definite pattern to form a protein molecule.
Annuals:	Plants that die after completing their life cycle within one growing season.
Anthesis:	Stage in floral development when pollen is shed.
Anaerobic:	Living in the absence of free oxygen; the opposite of aerobic.
Anti-quality Components:	Compounds like alkaloids, tannins, and other toxic compounds that cause problems in animal health and performance. Even if often present in small amounts, they can override the nutritional value of forage, even when the forage tests high for CP and TDN. Tall fescue endophyte contains a major anti-quality component. *Sericea lespedeza* is high in tannins, especially when mature.
Autotoxicity:	A specific type of allelopathy where the presence of adult plants of a species interferes with the germination and development of seedlings from that species.
Auriculated:	Having ear or hair like parts or extensions.

Term	Definition
Biennials:	A plant that completes its life cycle in two years.
Bloat:	Excessive accumulation of gases in the rumen (stomach) of an animal.
Boot Stage:	Growth stage when the sheath of the upper most leaf encloses a grass reproductive seedhead.
Bunch Grass:	Grass that produces a tufted growth or clump that gradually enlarges as tillers are produced around the outer edge of the tuft. (i.e. Timothy).
Carbohydrate:	Carbohydrates consist of simple and/or complex sugar molecules that function as readily available energy. Examples are fructose, glucose, sucrose, starch and hemi-cellulose.
Caryopses:	The grain or fruit of grasses.
Cellulose:	Major skeletal material in the cell wall of plants. Provides fiber for diet but minimal nutrition.
Compound Leaf:	A leaf separated into two or more leaflets.
Cool Season Plant:	A plant that makes its major growth during the cool part of the year, mainly in the spring but in some localities in the fall or winter.
Crude Protein (CP):	The total amount of protein, some of which is insoluble or non-degradable. Crude protein is measured in the laboratory by first measuring nitrogen and then multiplying by 6.25.
Cud:	Food regurgitated from the first stomach to the mouth of a ruminant and chewed again for further breakdown.
Cultivar:	The international term cultivar denotes an assemblage of cultivated plants that is clearly distinguished by any characters (morphological, physiological, cytological, chemical, or other) and when reproduced (sexually or asexually), retains its distinguished characters.
Culm:	The stem of a grass that has elongated internodes between nodes.
Decreaser:	Plant that is gradually replaced by other species in a stand.
Decumbent:	Lying or growing along the ground, but erect at or near the apex of some stems.
Dehiscent:	Splitting open along seed capsule or pod to emit individual seeds.
Digestible Dry Matter (DDM):	Digestibility estimated from ADF. The higher the ADF, the lower the digestibility.
Drought Tolerance:	The ability of a plant to withstand lack of rainfall for a portion of the year or for extended periods, sometimes multiple years.
Dry Matter (DM):	The percent of the forage that is not water.
Dry matter Intake (DMI):	Although it can be determined from feeding trials, it is usually estimated from NDF. The higher the NDF, the lower the intake.
Forage:	Herbaceous grasses and legumes available and acceptable to grazing animals.
Elliptic:	Longer than wide with rounded ends; rounded oval.
Ellipsoidal:	Three-dimensional object that is widest at the middle, tapers to ends of the same size, and is round in cross section.
Endophyte:	An organism (fungus, bacteria, nematode, etc...) growing inside of a plant.
Ensile:	To store forage as silage.
Friable Soil:	A soil with a readily crumbled or broken apart surface.
Glabrous:	Without hair, smooth.
Glumes:	A pair of bracts found at the base of a grass spikelet and not containing pistils or stamens; occasionally one or both glumes are absent.
Haylage:	Product resulting from ensiling forage with about 20-40% moisture, in the absence of oxygen.
Hemicellulose:	Polysaccharide fraction existing largely in the secondary cell wall of the plant.
Herbaceous:	Plants having aerial stems that die back to the soil level each year while the underground parts remain alive.
Introduced:	A species not part of the original fauna or flora of the area in question, but introduced from another geographical region through human activity.
Keel:	Projecting central rib usually found on the back of an organ and resembling a boat's keel.

Term	Definition
Lanceolate:	Much longer than wide, widest below the middle and tapering toward both ends, sometimes rounded at the base.
Lemma:	Lower bract of the grass floret, placed above the glumes with its back toward the outside of the spikelet or away from the rachilla.
Lignin:	Complex non-carbohydrate strengthening material in the thickened cell walls of plants; practically indigestible.
Lodging:	Collapse of top heavy plants, particularly grain crops, due to excessive growth or pressure from wind and rain.
Meadow:	An area of perennial herbaceous vegetation, usually grasses or grass like, used primarily for hay production.
Metabolic Energy:	Food intake gross energy minus fecal energy, minus energy in the gaseous products of digestion, minus urinary energy.
Monoculture:	Cultivation of a single species to the exclusion of other potential crops.
Native Plant / Species:	A plant that occurs naturally in a particular region, state, ecosystem, and habitat without direct or indirect human actions. Climate, soil, and biotic factors determine its presence and evolution in an area.
Net Energy (NE):	Calculated from ADF. Net energy estimates are used largely by dairy producers in ration balancing for maintenance (NEm), gain (NEg), and lactation (NEl).
Neutral Detergent Fiber (NDF):	An estimate of the portion of a forage sample that is in the walls of a plant cell. It is measured by boiling a forage sample in a neutral detergent and weighing the residue. Boiling removes the soluble components of the cell - most of the sugars, fats, starches, and proteins. The remaining residue is composed of cell walls made up of cellulose, hemicellulose, and lignin. The amount of NDF residue is inversely related to forage intake. High quality forages have low amounts of NDF.
Nitrate Poisoning:	Condition sometimes resulting when ruminants ingest nitrates (NO_3). The rumen bacteria convert to nitrite (NO_2); the nitrites compete with oxygen, tying up the oxygen-carrying mechanism in the blood and causing the animal to suffocate.
Node:	Joint on a stem, represented by position of origin of a leaf or bud
Oblique:	Lop-sided, one side of leaf base is larger, wider or more rounded than the other.
Oblong:	Two to four times longer than broad.
Obovate:	Inversely ovate, attached at the narrow end.
Obovoid:	Leaf shape that is inversely egg-shaped or ovoid.
Obtuse:	Blunt or rounded at the tip, with sides coming together at an angle greater than 90 °.
Oval:	Twice as long as broad, widest at the middle, both ends rounded.
Ovate:	Egg shaped in outline, narrower at the tip and attached at the larger end. Applies to flat surfaces.
Ovoid:	Egg shaped; Applies to three-dimensional structures.
Palatability:	The relish with which a particular species or plant part is consumed by an animal.
Palea:	Upper bract of the floret, placed above the lemma with its back toward the rachilla.
Palmate:	With three or more lobes, veins or leaflets arising from one point, often five to seven.
Pasture:	Grazing land comprised of introduced or domesticated native forage species that are used primarily for the production of livestock. These lands receive periodic renovation and/or cultural treatment (such as tillage, fertilization, mowing, weed control), and may be irrigated.
Perennials:	Plants that normally live for more than two years.
Petiole:	The stalk that joins a leaf to stem; (leaf stalk).
Petiolule:	The stalk of a leaflet of a compound leaf.
pH:	A measure of the hydrogen-ion concentration in a solution, expressed on a negative log 10 scale of 0 (highly acidic) to 14 (highly basic) with pH of 7 being neutral. See charts on page 23.
Pilose:	Long soft hairs.

Term	Definition
Pinnate:	Compound leaf with leaflets arranged on opposite side of common axis.
Prostrate:	Lying flat upon the ground and growing horizontally
Protein:	Essential part of all living matter and animal feed, consisting of a complex combination of amino acids, always containing carbon, hydrogen, oxygen, and nitrogen.
Pure Live Seed:	The portion (percentage) of the seed lot that is pure and viable.
Racemes:	Pedicled flowers along one stem.
Rachilla:	Axis of a grass spikelet; a stalk-like, sometimes jointed, structure extending above and between the glumes and bearing the florets.
Relative Feed Value (RFV):	An estimate of hay quality. It is calculated from NDF, ADF, and crude protein with emphasis on NDF. The RFV grading system assumes that full bloom alfalfa has a value of 100. Immature alfalfa has a higher RFV and stemmy alfalfa has a lower RFV.
Rhizome:	Underground stem, usually horizontal and capable of producing new shoots and roots at the nodes.
Rills:	Long, straight and narrow depressions on a soil surface, caused by water erosion.
Rumen:	The large, first compartment of the stomach of a ruminant from which ingested food is regurgitated for chewing and in which digestion is aided by the symbiotic action of microbes.
Ruminant:	Even toed, hoofed mammal that chews the cud and has a four chambered stomach.
Rust:	A parasitic fungi that is harmful to other plants.
Saline Soil:	A soil condition in which soluble salts are present in the soil in sufficient quantities to affect the ability of plants to absorb water from the soil.
Salt Tolerance:	Relative ability of a plant to reproduce and grow under saline conditions.
Scabrous:	Slightly roughened.
Selected Class Release:	Phenotypically selected plants of untested parentage that have promise, but no proof of genetic superiority of distinctive traits.
Seedhead:	The inflorescence (flowering part) of a grass where the seed will develop.
Shade Tolerance:	Relative ability of a plant to reproduce and grow under shade.
Silage:	Forage preserved in a succulent condition by partial fermentation.
Sod grass:	Grass that is spread vegetatively by the growth of underground stems, called rhizomes. (i.e. Smooth Brome).
Soil Texture:	The relative portion (percentage) of sand, silt and clay in the soil.
Stage of Maturity:	The development of a forage used to describe a point in time in its progress toward maturity and readiness for harvest of forage, hay, or seed.
Stipules:	Very small stalk of an organ; a small prolongation of a rachilla beyond the uppermost floret in the spikelets of some grasses.
Stolon:	A horizontal stem which grows along the surface of the soil and roots at the nodes.
Stools:	A stump of root stock producing shoots or suckers.
Swath:	A strip of cut herbage lying on the stubble left by a cutter bar, blade, flail, rotary drum, mower, mower-conditioner, binder, swather, or small grain head on a combine.
Taproot:	A plant root system dominated by a large primary root, normally growing straight downward, from which most of the smaller roots spread out laterally.
Total Digestible Nutrients (TDN):	An estimate of digestible forage. TDN is not measured directly but is calculated from ADF. TDN is used by many beef producers to balance rations.
Trifoliate:	A pinnate leaf form with three leaflets.
Ungulate:	A hoofed animal; includes ruminants, but also includes horses and swine.
Vegetative:	Term used to designate stem and leaf development in contrast to flower and seed development.
Water Tolerance:	Relative ability of a plant to reproduce and grow under saturated or flooded conditions.
Yield:	The quantity of a product in a given space and/or time. Also known as the harvested portion of a product.

Works Cited

Adesogan, A.T., & Newman, Y.C. (2010). Silage Harvesting, Storing, and Feeding. IFAS Extension, University of Florida, Gainesville, Florida.
Retrieved from http://edis.ifas.ufl.edu/ag180

Harper, J.L. (1977). Population Biology of Plants, New York: Academic Press.

Pieper, R.D. 1978. Measurement Techniques for Herbaceous and Shrubby Vegetation. New Mexico State University: Las Cruces, NM.

Ogle, D. , St. John, L., Cornwell, J., Stannard, M. , Holzworth, L. (2008 January). Pasture and Range Seedings, Planning-Installation-Evaluation-Management. Plant Materials Technical Note 10. USDA- Natural Resources Conservation Service, Boise, Idaho, Bozeman, Montana, Spokane, Washington.

Heady, F. H., & Child, D. R. (1994) Rangeland Ecology & Management. Westview Press, Inc. Boulder, CO

Holechek, L. J., Pieper, D. R., Herbel, H. C. (2004) Range Management Principles and Practices Fifth Edition. Pearson Prentice Hall. Upper Saddle River, NJ

Huggins, R. D., Reganold, P. J. (2008) No-Till: the Quiet Revolution. *in* Scientific American, July 2008 issue, 8p. (p. 70-77)
Retrieved from: http://research.wsu.edu/resources/files/no-till.pdf

Livestock Production Program (2006). Silage. Livestock Production Programme (LPP), Department for International Development, UKAID.
Retreived from http://www.smallstock.info/tools/feed/silage/silage1.htm

Livestock Production Program (2006). Hay Making. Livestock Production Programme (LPP), Department for International Development, UKAID.
Retreived from http://www.smallstock.info/tools/feed/hay/haymaking1.htm#mycotoxins

Mhere, O., Maasdorp, B., Titterton, M. (2002). Forage Production and Conservation Manual: UK Dept. for International Development, Livestock Production Research Programme (LPP)
Retrieved from http://www.smallstock.info/research/reports/R7010/R7010-Manual.pdf

Ogle, D., Englert, J., Gibbs, J. (2001 January). Glossary of Terms for Use in Plant Materials.
Retrieved from http://plant-materials.nrcs.usda.gov/pubs/idpmctn280101.pdf

Quarberg, D. (n.d.). Buyer's Guide to Forage Products. Cooperative Extension Service, University of Alaska Fairbanks, Fairbanks, Alaska.
Retrieved from http://www.uaf.edu/ces/publications-db/catalog/anr/FGV-00145B.pdf

Saskatchewan Ministry of Agriculture. (2011). 2011 Forage Crop Production Guide. 20 p.
Retrieved from http://www.agriculture.gov.sk.ca/Forage-Crop-Production-Guide.

Sullivan, P. (2003). Conservation Tillage. National Sustainable Agricultural Information Service
Retrieved from https://attra.ncat.org/attra-pub/conservationtillage.html

Whisenant, S. (1999). Repairing Damaged Wildlands - A Process-Orientated, Landscape-Scale Approach. (5th ed.). New York: Cambridge University Press

Vallentine, J.F. (1989). Range Developments and Improvements. New York: Academic Press