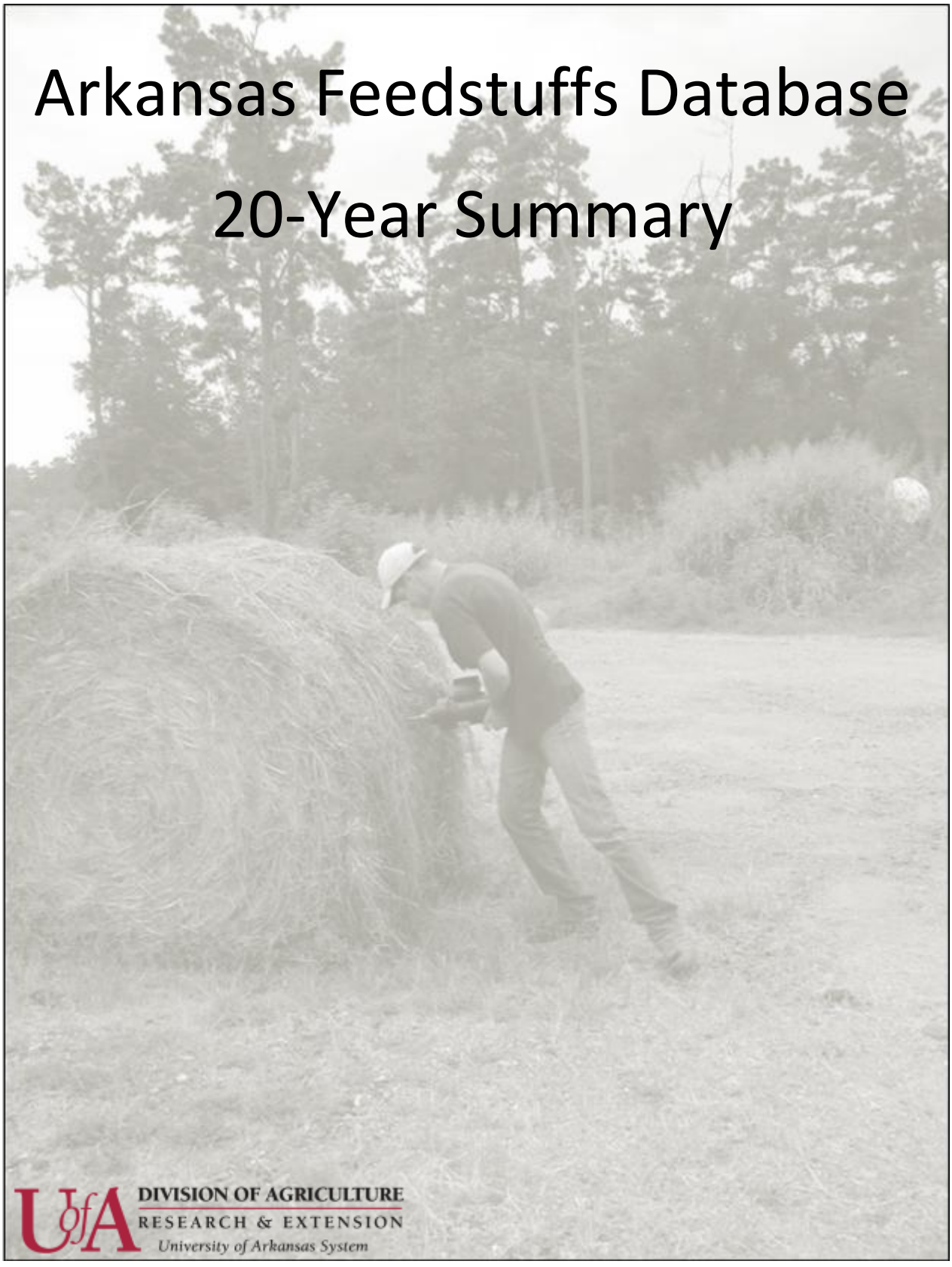
Arkansas Feedstuffs Database

20-Year Summary



DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

University of Arkansas, United States Department of Agriculture, and County Governments Cooperating

Preface

Beginning in 1985, an Arkansas feedstuff analysis results database was developed by Dr. George Davis (retired professor with the University of Arkansas, Cooperative Extension Service and Department of Animal Science). Through the local county Cooperative Extension office, livestock producers and hay producers submit forage and feed samples to the University of Arkansas, Agriculture Diagnostics Laboratory for dietary nutrient determination (Appendix A). In addition, samples are also submitted for extension-specific programs, including demonstrations and hay shows. Feedstuffs submitted to the lab include forages (hay, silage and pasture samples), poultry house litter, and grains/other (whole grains, byproduct feeds and mixed feeds). The grains and other samples are few in number and too variable in type to generate a meaningful summary.

This publication provides a 20-year review of hay, pasture and litter sample analysis results. Information is presented in tabular and graphical form. Nutrient values are reported on a dry matter (DM) basis unless stated differently. The equation routinely used to estimate total digestible nutrient (Appendix B) of warm-season grasses in Arkansas [TDN = 111.8 + 0.95(CP) – 0.36(ADF) – 0.70(NDF)] can over-estimate TDN when crude protein is high. As a result, a substitute equation (used by other states in the southeastern U.S.) was used to estimate TDN of warm-season grasses [87.46 + (0.20(CP(0.876)-2.38)) - 0.96(ADF)] for this publication.

For interpretation of hay test results, the Understanding Your Hay Analysis Report is included at the end of this publication (Appendix C).

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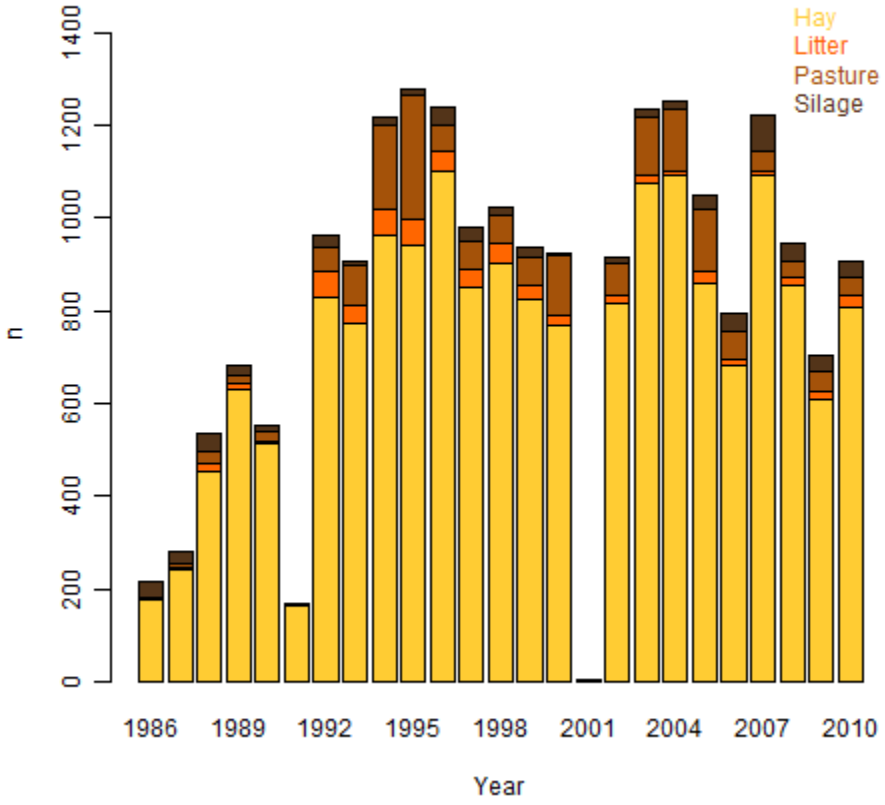
Table of abbreviations

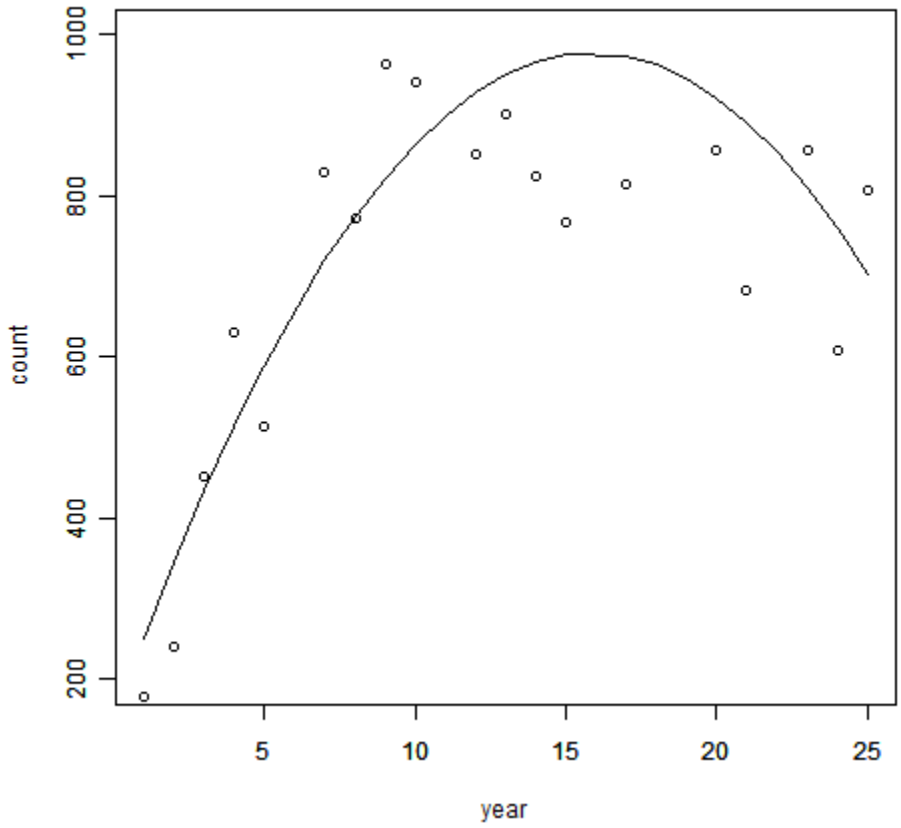
Unit	Abbreviation
Feedstuff terms	
Acid detergent fiber	ADF
Calcium	Ca
Copper	Cu
Crude protein	CP
Dry matter	DM
Iron	Fe
Magnesium	Mg
Manganese	Mn
Neutral detergent fiber	NDF
Nitrate-nitrogen	NNO_3
Phosphorus	P
Potassium	K
Relative feed value	RFV
Sodium	Na
Sulfur	S
Total digestible nutrients	TDN
Zinc	Zn
Nutrient removal (fertilizer equivalent)	
Nitrogen	N
Phosphate	P_2O_5
Potash	K_2O
Statistical terms	
Confidence interval	CI
Maximum	max
Minimum	min
Number of observations	n
Standard Deviation	SD

All samples summary: Annual number of non-grain feedstuff samples submitted to the University of Arkansas, Agriculture Diagnostics Laboratory.



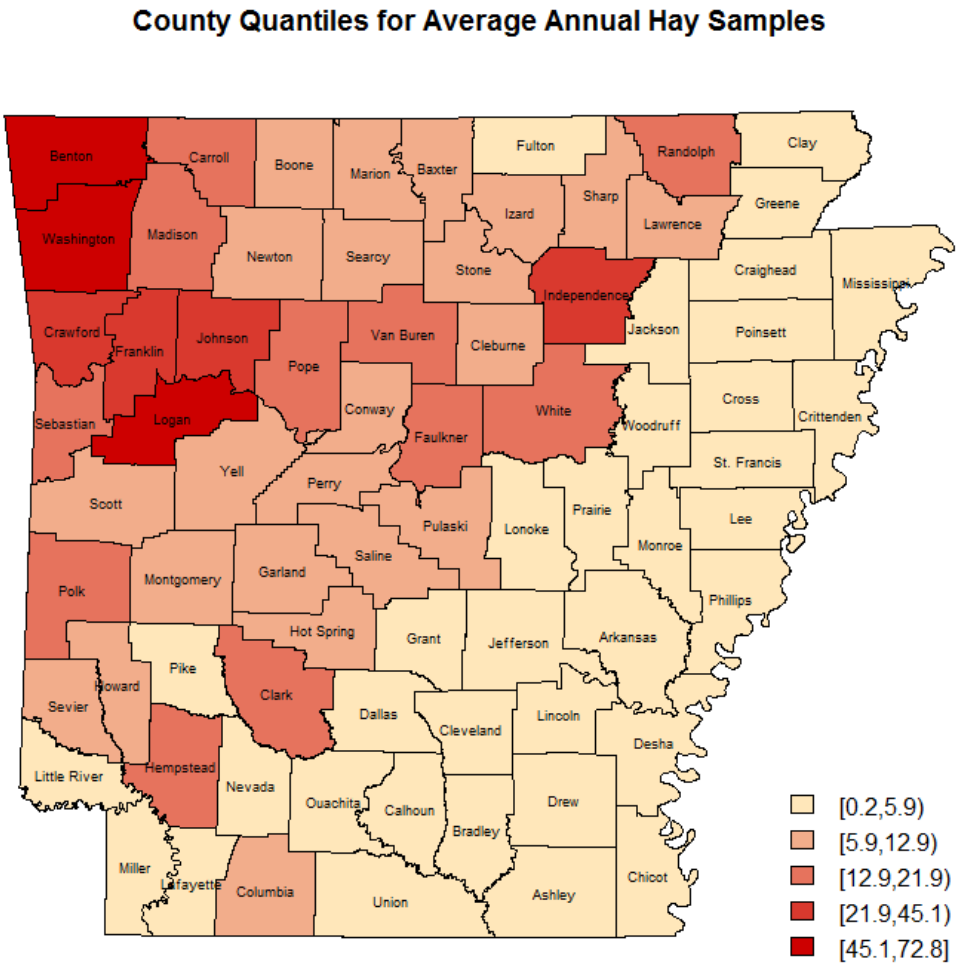
Summary statement: The number of hay, litter, pasture and silage samples submitted from 1996 to 2010 averaged 837, with a minimum of 214 and maximum of 1,280 (excluding counts from 1991 and 2001). Samples for 1991 and 2001 were lost during database maintenance. Overall, hay, litter, pasture and silages represented 86.1%, 2.8%, 8.2% and 2.9% of the total, respectively, but proportionately differed by year (chi square test, $P < 0.001$).

Hay summary: Number of hay samples submitted over the 25-year period of 1986 to 2010.



Summary statement: The number of hay samples submitted for analysis has varied from year to year, but overall there appears to be a downward trend in number of hay samples being submitted. The reason for this trend is not clear, but possible reasons may include changes in farm numbers, producers pooling multiple hay lots into single samples, or program awareness.

Hay summary: Average annual number of hay samples submitted by county (1990 – 2010).



Summary statement: The average annual number of hay samples submitted by county was categorized into one of five quantiles. The average excludes values for 1991 and 2001, which were lost during database maintenance.

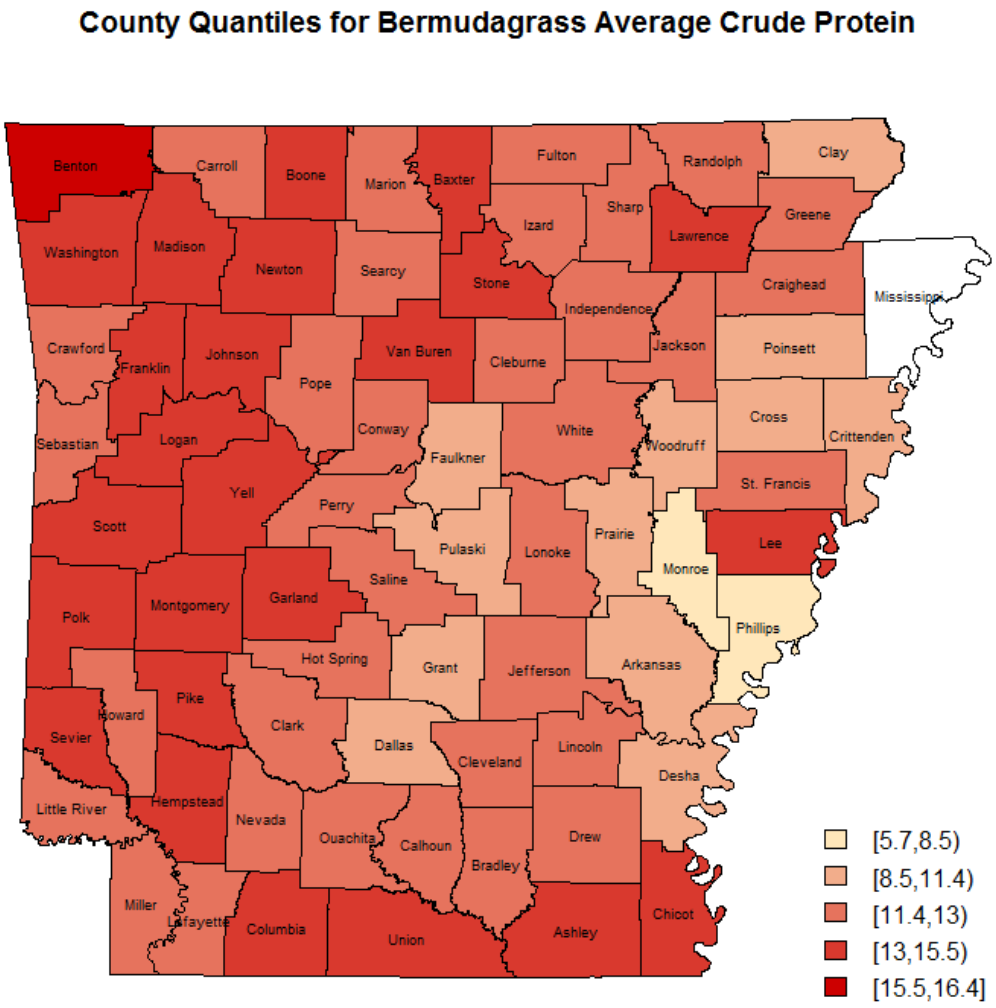
Hay summary: Percentage of hay samples by forage species.

Forage type	Percentage of total hay samples
Alfalfa	2.3
Alfalfa-Grass Mixture	0.4
Bahiagrass	2.1
Bermudagrass	39.3
Bluestems	0.2
Bromegrass	0.1
Clover	0.2
Dallisgrass	0.3
Fescue	8.3
Johnsongrass	1.6
Legume-Grass Mixture	1.6
Mixed Grass	31.9
Native Grass or Weed	1.5
Oat	0.2
Orchardgrass	1.5
Rye	0.4
Ryegrass	2.1
Sorghum-Grain Type	0.6
Sorghum-Silage Type	0.1
Sorghum-Sudangrass	4.1
Soybean	0.1
Straw of Small Grain	0.2
Wheat	0.7

Other samples represent less than 0.1% and contribute to the difference between these values and 100%.

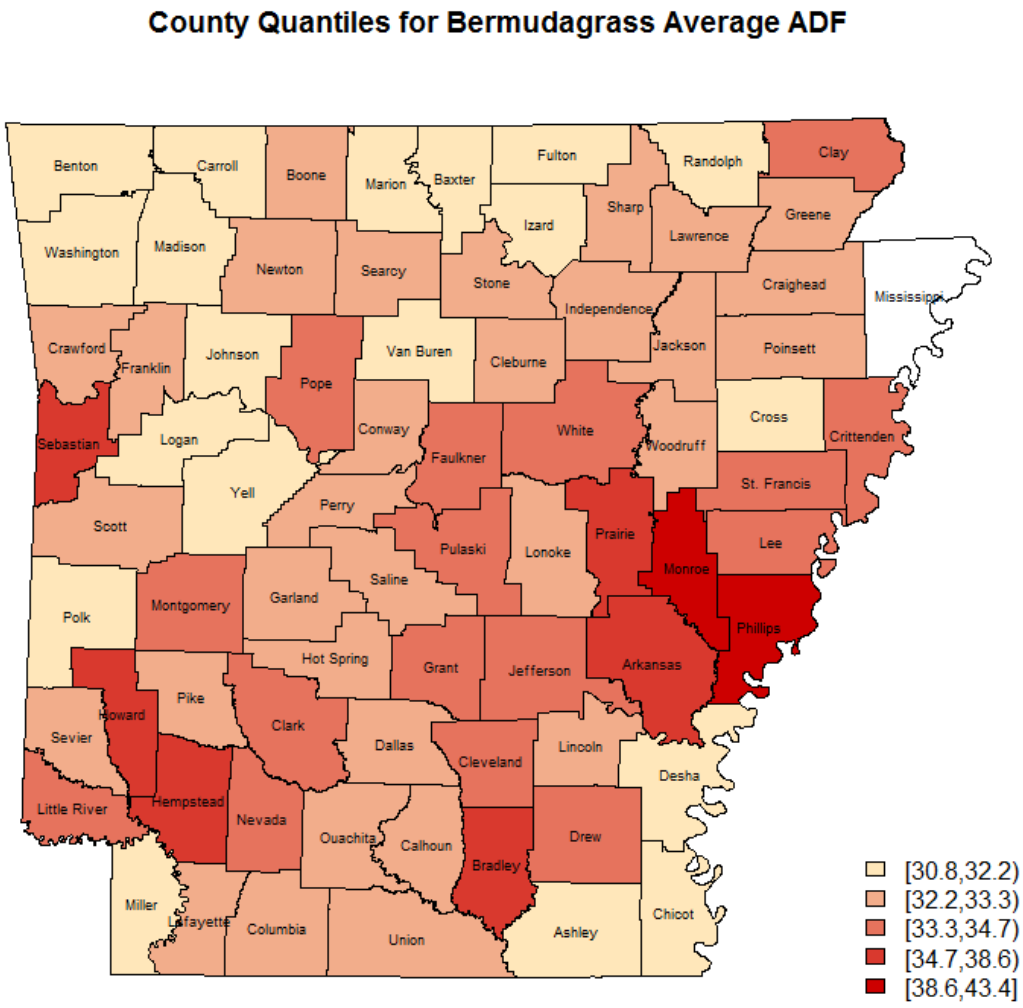
Summary statement: Bermudagrass and mixed grass samples represented 71.2% of all hay samples submitted. Fescue represented 8.3%. Mixed grass samples are considered cool-season and warm-season mixed grass stands such as a late-spring to early summer harvest of a ryegrass and bermudagrass mixture.

Hay summary: Average CP of bermudagrass hay samples by county (1990 – 2010).



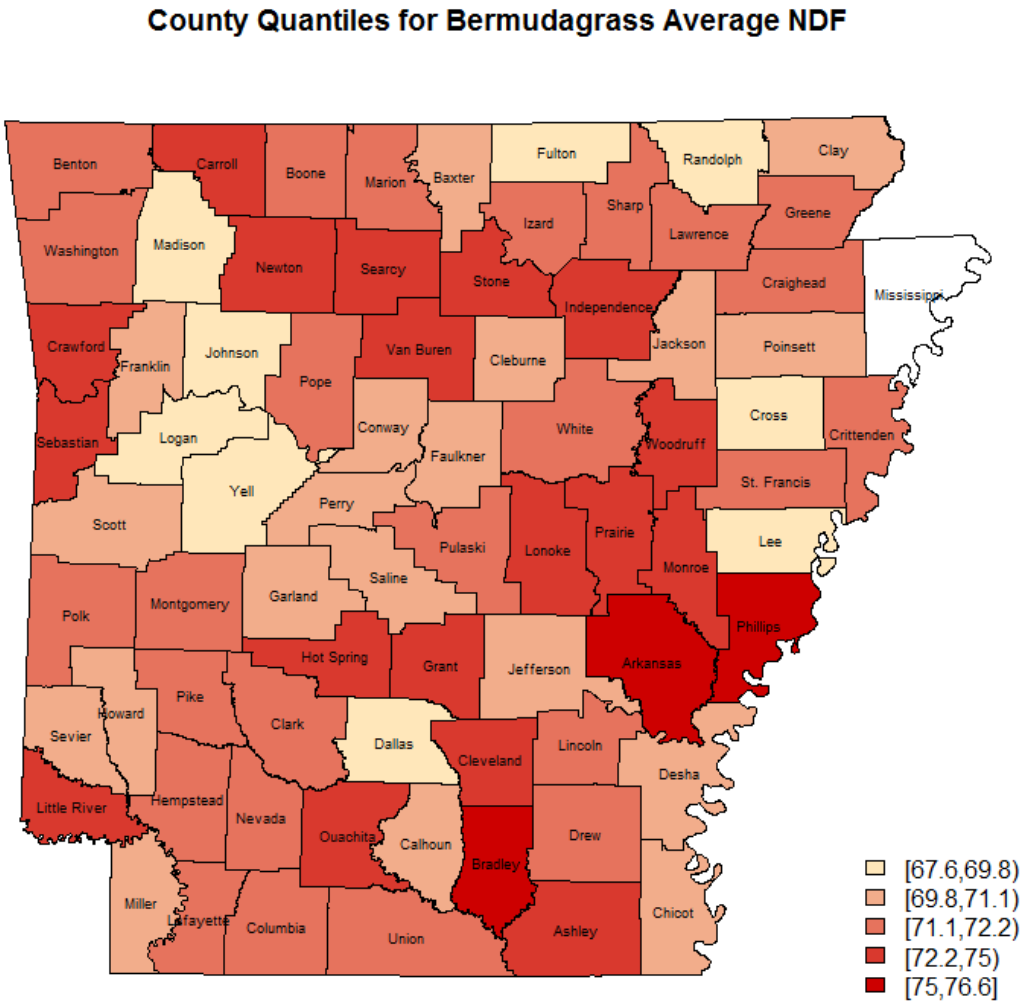
Summary statement: Counties without a fill color indicate no observations.

Hay summary: Average ADF of bermudagrass hay samples by county (1990 – 2010).



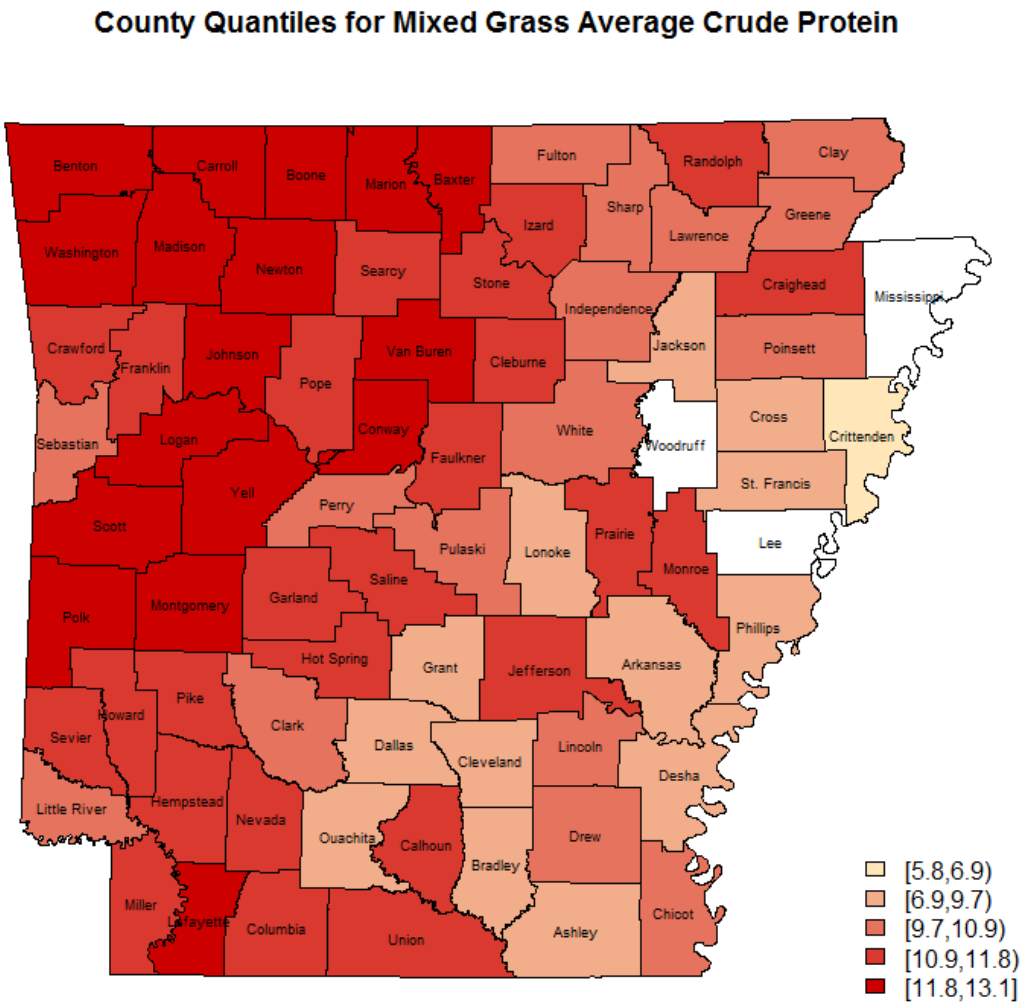
Summary statement: Counties without a fill color indicate no observations.

Hay summary: Average NDF of bermudagrass hay samples by county (1990 – 2010).



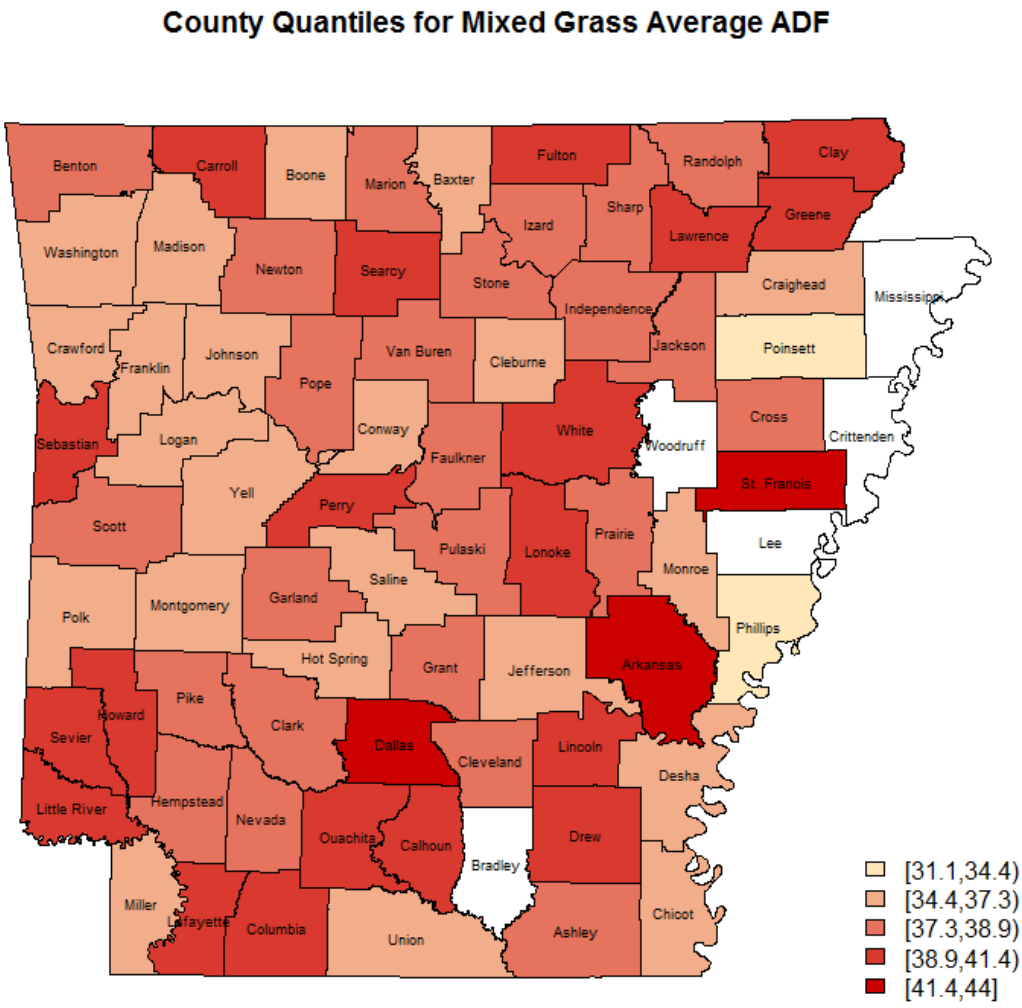
Summary statement: Counties without a fill color indicate no observations.

Hay summary: Average CP of mixed grass hay samples by county (1990 – 2010).



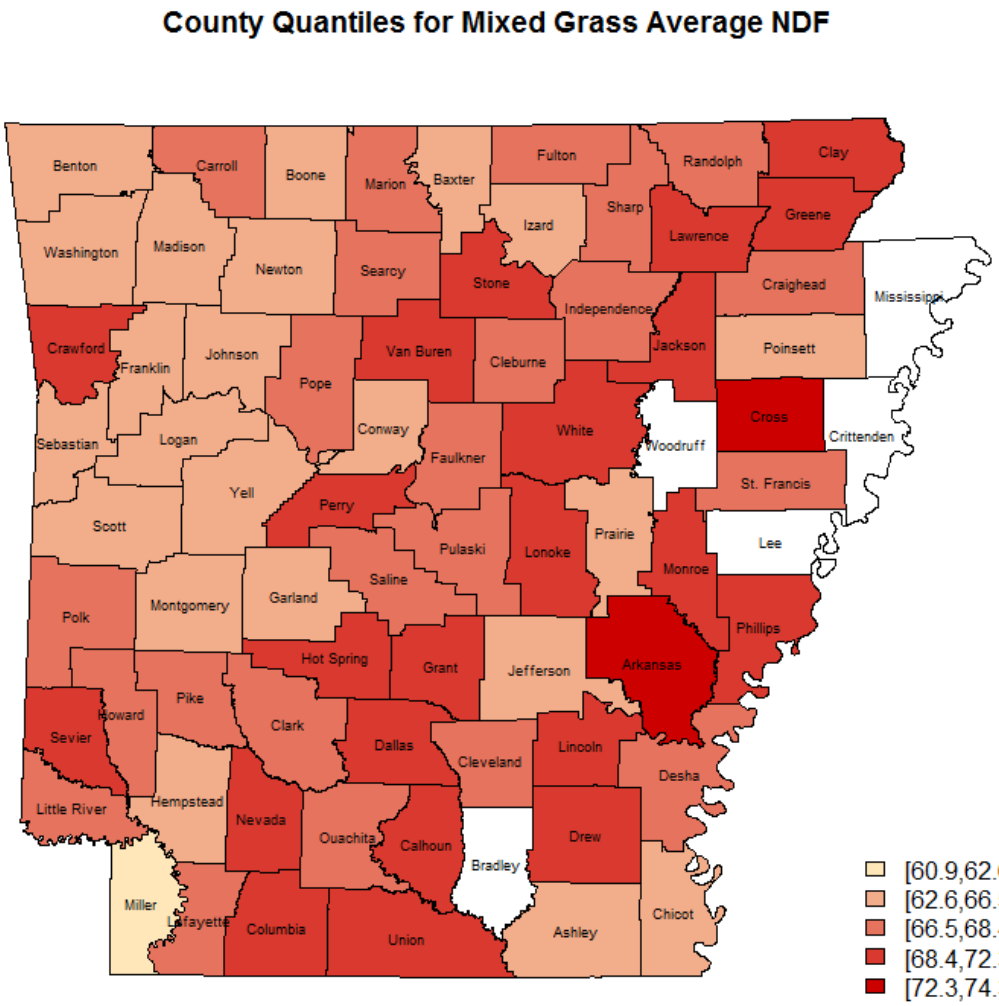
Summary statement: Counties without a fill color indicate no observations.

Hay summary: Average ADF of mixed grass hay samples by county (1990 – 2010).



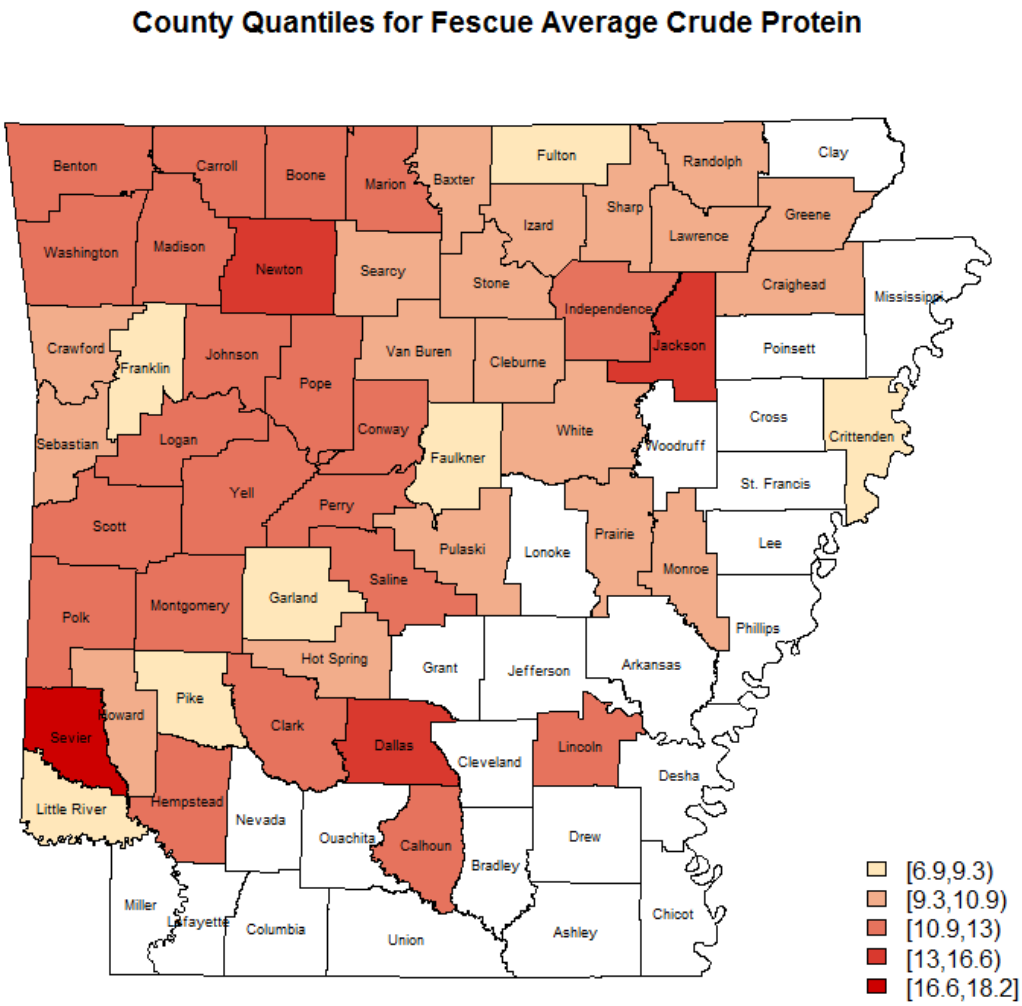
Summary statement: Counties without a fill color indicate no observations.

Hay summary: Average NDF of mixed grass hay samples by county (1990 – 2010).



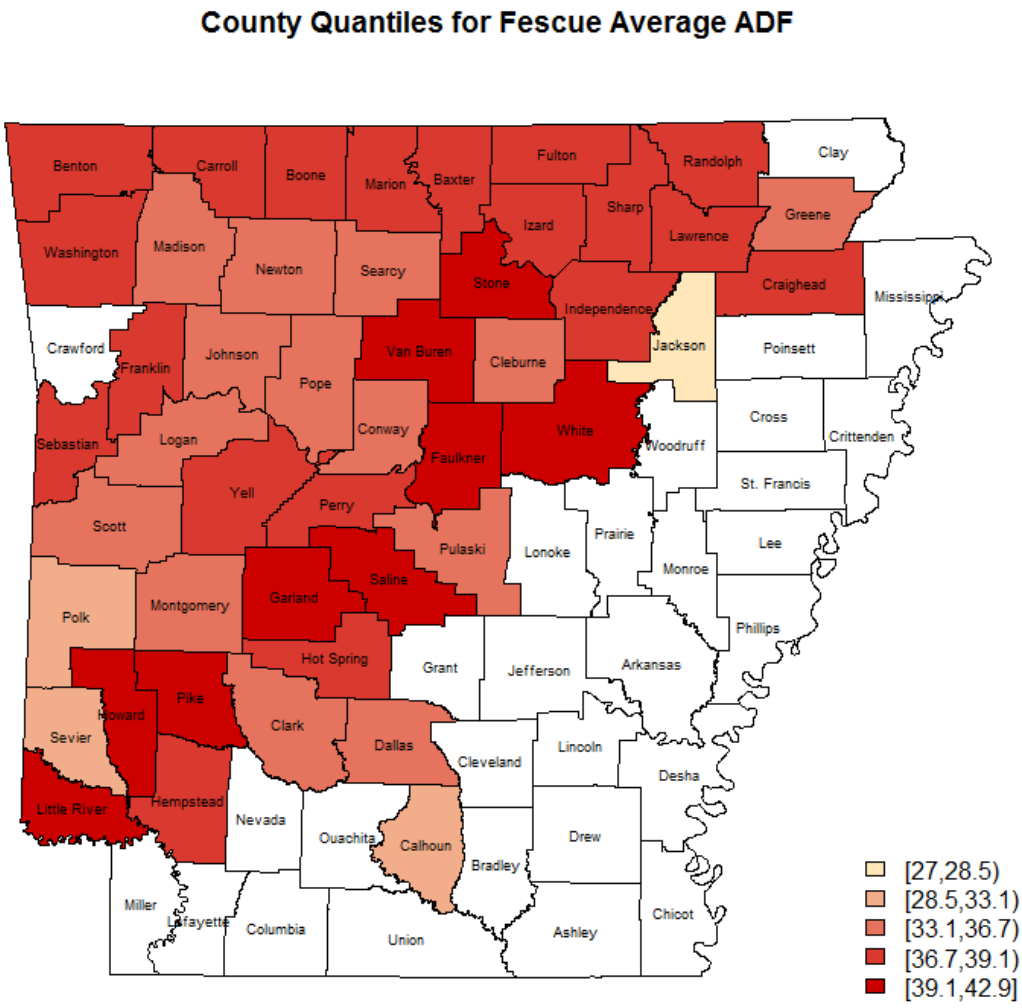
Summary statement: Counties without a fill color indicate no observations.

Hay summary: Average CP of fescue hay samples by county (1990 – 2010).



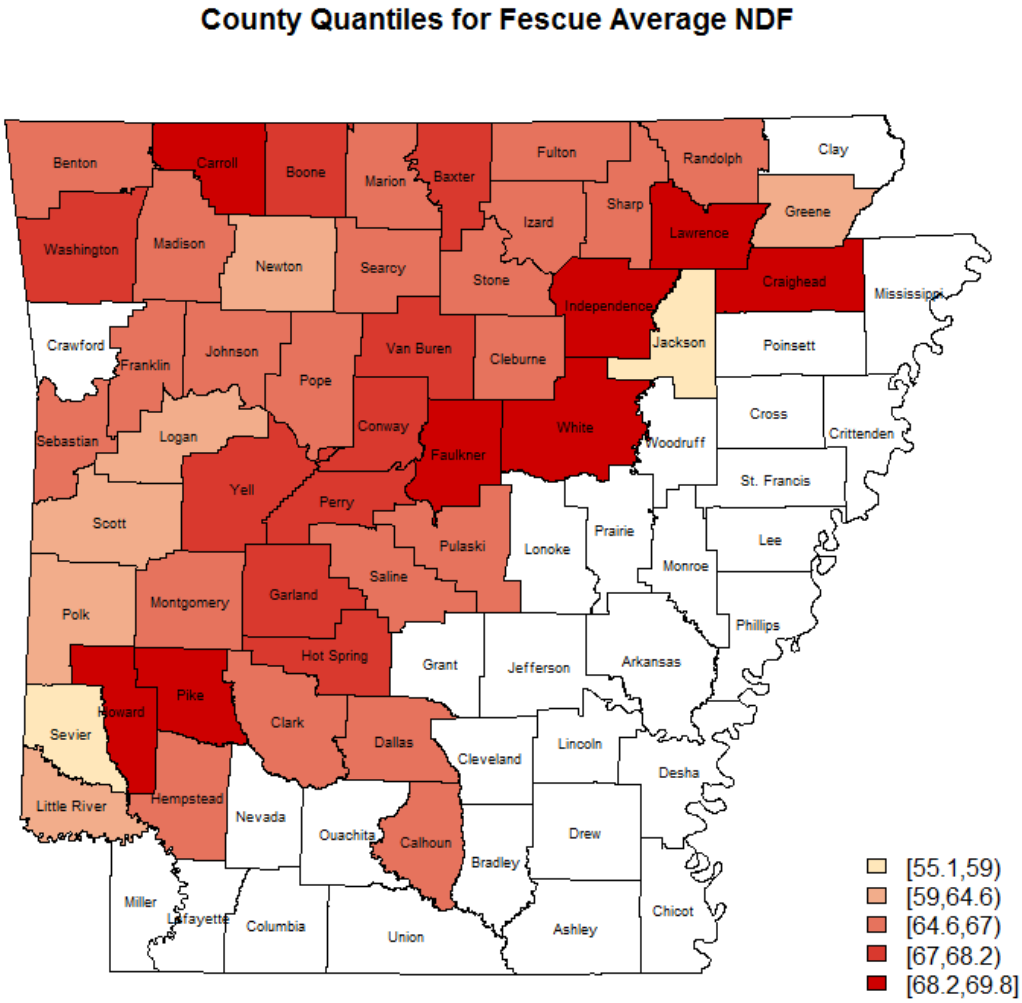
Summary statement: Counties without a fill color indicate no observations.

Hay summary: Average ADF of fescue hay samples by county (1990 – 2010).



Summary statement: Counties without a fill color indicate no observations.

Hay summary: Average NDF of fescue hay samples by county (1990 – 2010).



Summary statement: Counties without a fill color indicate no observations.

Hay summary: Table of pair complete correlations among hay analysis variables.

	CP	ADF	NDF	NNO_3	P	K	Ca	Mg	Na	S	Fe	Mn	Cu	Zn	TDN
CP		-0.53	-0.28	0.42	0.48	0.53	0.33	0.18	0.21	0.56	0.02	-0.30	0.31	0.22	0.70
ADF			0.19	-0.21	-0.19	-0.35	-0.05	0.01	-0.16	-0.48	0.23	0.32	-0.07	0.04	-0.81
NDF				-0.09	-0.19	-0.16	-0.38	-0.21	-0.07	0.21	-0.01	-0.05	-0.05	-0.11	-0.23
NNO_3					0.32	0.42	0.04	0.20	0.15	0.30	-0.01	-0.14	0.19	0.26	0.31
P						0.55	0.34	0.29	0.22	0.37	0.07	-0.32	0.32	0.37	0.34
K							0.10	0.12	0.10	0.36	-0.10	-0.30	0.22	0.17	0.46
Ca								0.35	0.19	0.08	0.20	-0.15	0.18	0.11	0.17
Mg									0.19	0.05	0.11	0.09	0.18	0.21	0.10
Na										0.27	0.08	-0.03	0.14	0.07	0.18
S											-0.00	-0.27	0.19	0.13	0.53
Fe												0.22	0.30	0.18	-0.11
Mn													-0.01	0.08	-0.31
Cu														0.36	0.18
Zn															0.14

Summary statement: Correlations are relationships that have a scale from -1 to +1. Values close to zero indicate weak relationships, and values close to -1 or +1 indicate strong relationships. Relationships that are (-) indicate as one variable increases in value, the other decreases. Relationships that are (+) indicate as one variable increases in value, the other also increases. For example, CP and ADF have a moderately strong, but negative relationship (-0.53). Therefore, hay samples with higher CP would have lower ADF.

Hay summary: Table of nutrient composition results for alfalfa.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	401	88.38	3.78	84.60	92.16
CP, %	405	19.61	4.04	15.57	23.65
ADF, %	293	31.39	6.21	25.18	37.60
NDF, %	293	42.90	8.95	33.95	51.85
NNO_3, ppm	44	606.05	256.27		
P, %	37	0.31	0.05	0.26	0.36
K, %	30	2.14	0.41	1.73	2.55
Ca, %	25	1.17	0.26	0.91	1.43
Mg, %	29	0.27	0.06	0.21	0.33
Na, %	22	0.04	0.02	0.02	0.06
S, %	29	0.24	0.07	0.17	0.31
Fe, ppm	8	233.12	87.01		
Mn, ppm	8	65.75	22.82		
Cu, ppm	9	9.83	2.37		
Zn, ppm	9	20.82	7.19		
TDN, %	406	63.43	7.00	56.43	70.43
RFV,%	293	146.72	35.75	110.97	182.47
Fertilizer Equivalent					
P_2O_5, lb/ton	36	12.43	2.20	10.23	14.63
N, lb/ton	399	55.24	11.36	43.88	66.60
K_2O, lb/ton	29	45.67	8.98	36.69	54.65

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for alfalfa-grass mixture.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	74	88.40	3.60	84.80	92.00
CP, %	78	16.50	4.43	12.07	20.93
ADF, %	48	31.69	4.97	26.72	36.66
NDF, %	48	52.35	9.51	42.84	61.86
NNO_3, ppm	18	632.11	308.05		
P, %	4	0.37	0.02		
K, %	2	2.54	0.20		
Ca, %	4	0.91	0.36		
Mg, %	3	0.23	0.04		
Na, %	2	0.01	0.00		
S, %	2	0.22	0.02		
Fe, ppm	1	98.00	NA		
Mn, ppm	1	169.00	NA		
Cu, ppm	1	15.70	NA		
Zn, ppm	1	23.00	NA		
TDN, %	78	60.03	6.33	53.70	66.36
RFV,%	48	118.38	25.39	92.99	143.77
Fertilizer Equivalent					
P_2O_5, lb/ton	4	15.11	0.93		
N, lb/ton	74	46.76	12.76	34.00	59.52
K_2O, lb/ton	2	54.73	4.70		

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for bahiagrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	372	87.92	4.42	83.50	92.34
CP, %	374	9.78	2.76	7.02	12.54
ADF, %	369	38.49	3.79	34.70	42.28
NDF, %	369	70.09	5.35	64.74	75.44
NNO_3, ppm	104	373.99	176.78		
P, %	88	0.21	0.06	0.15	0.27
K, %	88	1.33	0.41	0.92	1.74
Ca, %	88	0.50	0.15	0.35	0.65
Mg, %	88	0.25	0.05	0.20	0.30
Na, %	85	0.02	0.02	0.00	0.04
S, %	86	0.18	0.03	0.15	0.21
Fe, ppm	85	188.60	123.47	65.13	312.07
Mn, ppm	85	310.22	144.35	165.87	454.57
Cu, ppm	85	10.43	3.48	6.95	13.91
Zn, ppm	85	30.99	12.14	18.85	43.13
TDN, %	369	51.74	3.83	47.91	55.57
RFV,%	369	78.81	9.04	69.77	87.85
Fertilizer Equivalent					
P_2O_5, lb/ton	88	8.44	2.49	5.95	10.93
N, lb/ton	372	27.45	7.81	19.64	35.26
K_2O, lb/ton	88	27.94	8.03	19.91	35.97

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for bermudagrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	6352	87.98	4.59	83.39	92.57
CP, %	6540	13.20	3.64	9.56	16.84
ADF, %	6477	32.59	3.97	28.62	36.56
NDF, %	6477	71.21	5.23	65.98	76.44
NNO_3, ppm	2444	811.50	775.29		
P, %	1152	0.30	0.08	0.22	0.38
K, %	1118	1.98	0.51	1.47	2.49
Ca, %	968	0.53	0.15	0.38	0.68
Mg, %	954	0.22	0.07	0.15	0.29
Na, %	581	0.04	0.03	0.01	0.07
S, %	963	0.30	0.10	0.20	0.40
Fe, ppm	769	197.80	129.53	68.27	327.33
Mn, ppm	775	145.01	95.70	49.31	240.71
Cu, ppm	791	10.86	4.19	6.67	15.05
Zn, ppm	771	35.26	14.53	20.73	49.79
TDN, %	6473	58.01	4.16	53.85	62.17
RFV,%	6477	83.53	8.80	74.73	92.33
Fertilizer Equivalent					
P_2O_5, lb/ton	1002	12.04	3.35	8.69	15.39
N, lb/ton	6346	37.01	10.25	26.76	47.26
K_2O, lb/ton	973	42.32	11.40	30.92	53.72

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for bluestems.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	39	89.23	4.08	85.15	93.31
CP, %	39	9.72	3.41	6.31	13.13
ADF, %	39	38.45	4.34	34.11	42.79
NDF, %	39	66.64	4.37	62.27	71.01
NNO_3, ppm	11	439.27	133.34		
P, %	11	0.22	0.10	0.12	0.32
K, %	11	1.71	0.76	0.95	2.47
Ca, %	11	0.50	0.12	0.38	0.62
Mg, %	11	0.22	0.06	0.16	0.28
Na, %	8	0.02	0.02		
S, %	11	0.19	0.06	0.13	0.25
Fe, ppm	11	134.27	47.02	87.25	181.29
Mn, ppm	11	112.55	47.94	64.61	160.49
Cu, ppm	11	9.70	3.61	6.09	13.31
Zn, ppm	11	28.34	9.52	18.82	37.86
TDN, %	39	60.54	5.27	55.27	65.81
RFV,%	39	82.76	8.55	74.21	91.31
Fertilizer Equivalent					
P_2O_5, lb/ton	11	8.64	3.98	4.66	12.62
N, lb/ton	39	27.78	9.87	17.91	37.65
K_2O, lb/ton	11	36.35	15.46	20.89	51.81

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for bromegrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	18	87.48	6.88	80.60	94.36
CP, %	19	9.80	3.04	6.76	12.84
ADF, %	18	37.46	4.47	32.99	41.93
NDF, %	18	64.39	4.86	59.53	69.25
NNO_3, ppm	4	430.00	184.44		
P, %	2	0.24	0.18		
K, %	2	1.50	0.71		
Ca, %	2	0.54	0.13		
Mg, %	1	0.12	NA		
Na, %	1	0.02	NA		
S, %	2	0.30	0.31		
Fe, ppm	1	106.00	NA		
Mn, ppm	1	66.00	NA		
Cu, ppm	1	7.40	NA		
Zn, ppm	1	9.10	NA		
TDN, %	19	56.14	4.14	52.00	60.28
RFV,%	18	86.88	9.47	77.41	96.35
Fertilizer Equivalent					
P_2O_5, lb/ton	1	4.51	NA		
N, lb/ton	18	26.22	6.83	19.39	33.05
K_2O, lb/ton	1	21.52	NA		

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for clover.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	34	87.57	4.25	83.32	91.82
CP, %	34	14.25	3.24	11.01	17.49
ADF, %	31	36.44	5.36	31.08	41.80
NDF, %	31	53.78	9.32	44.46	63.10
NNO_3, ppm	8	367.50	116.01		
P, %	5	0.28	0.06		
K, %	5	1.83	0.22		
Ca, %	4	1.13	0.35		
Mg, %	5	0.28	0.03		
Na, %	2	0.02	0.01		
S, %	5	0.20	0.01		
Fe, ppm	3	505.33	269.94		
Mn, ppm	3	139.33	77.11		
Cu, ppm	5	13.60	2.60		
Zn, ppm	3	56.23	25.45		
TDN, %	34	56.62	5.07	51.55	61.69
RFV,%	31	109.15	27.65	81.50	136.80
Fertilizer Equivalent					
P_2O_5, lb/ton	5	11.39	2.62		
N, lb/ton	34	39.84	8.95	30.89	48.79
K_2O, lb/ton	5	39.70	4.98		

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for dallisgrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	48	87.78	3.79	83.99	91.57
CP, %	48	10.60	3.24	7.36	13.84
ADF, %	48	37.80	4.85	32.95	42.65
NDF, %	48	68.75	6.06	62.69	74.81
NNO_3, ppm	14	454.43	460.28	0.00	914.71
P, %	9	0.24	0.05		
K, %	9	1.68	0.36		
Ca, %	9	0.41	0.11		
Mg, %	9	0.24	0.08		
Na, %	9	0.03	0.01		
S, %	10	0.23	0.06		
Fe, ppm	8	442.00	213.65		
Mn, ppm	8	318.25	101.84		
Cu, ppm	8	9.50	2.00		
Zn, ppm	8	25.20	3.97		
TDN, %	48	52.55	4.99	47.56	57.54
RFV,%	48	81.30	10.95	70.35	92.25
Fertilizer Equivalent					
P_2O_5, lb/ton	9	9.04	1.87		
N, lb/ton	48	29.76	9.22	20.54	38.98
K_2O, lb/ton	9	34.10	7.61		

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for fescue.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	1211	87.51	4.64	82.87	92.15
CP, %	1214	11.33	2.92	8.41	14.25
ADF, %	723	37.18	4.46	32.72	61.64
NDF, %	723	66.61	5.55	61.06	72.16
NNO_3, ppm	649	948.65	1395.86		
P, %	121	0.32	0.08	0.24	0.40
K, %	116	2.01	0.66	1.35	2.67
Ca, %	121	0.51	0.14	0.37	0.65
Mg, %	117	0.25	0.06	0.19	0.31
Na, %	76	0.03	0.03	0.00	0.06
S, %	110	0.20	0.05	0.15	0.25
Fe, ppm	76	166.11	129.66	36.45	295.77
Mn, ppm	76	149.93	103.80	46.13	253.73
Cu, ppm	85	9.33	3.61	5.72	12.94
Zn, ppm	76	27.14	11.21	15.93	38.35
TDN, %	1209	54.19	4.57	49.62	58.76
RFV,%	723	84.59	11.35	73.24	95.94
Fertilizer Equivalent					
P_2O_5, lb/ton	112	12.37	3.19	9.18	15.56
N, lb/ton	1206	31.64	8.17	23.47	39.81
K_2O, lb/ton	107	41.23	12.37	28.86	53.60

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for johnsongrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	119	86.22	5.69	80.53	91.91
CP, %	125	11.24	3.14	8.10	14.38
ADF, %	110	38.18	4.63	33.55	42.81
NDF, %	110	66.89	4.95	61.94	71.84
NNO_3, ppm	230	815.48	1019.49		
P, %	15	0.30	0.09	0.21	0.39
K, %	14	1.81	0.65	1.16	2.46
Ca, %	14	0.59	0.19	0.40	0.78
Mg, %	14	0.30	0.06	0.24	0.36
Na, %	7	0.02	0.01	0.01	0.03
S, %	14	0.16	0.04	0.12	0.20
Fe, ppm	8	240.50	113.44	127.06	353.94
Mn, ppm	8	134.00	36.35	97.65	170.35
Cu, ppm	11	11.07	3.27	7.80	14.34
Zn, ppm	8	44.26	22.05	22.21	66.31
TDN, %	124	61.88	4.91	56.97	66.79
RFV,%	110	82.95	10.08	72.87	93.03
Fertilizer Equivalent					
P_2O_5, lb/ton	13	11.55	2.97	8.58	14.52
N, lb/ton	119	31.21	8.70	22.51	39.91
K_2O, lb/ton	12	35.21	10.46	24.75	45.67

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for legume-grass mixtures.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	267	87.12	5.06	82.06	92.18
CP, %	278	12.85	3.44	9.41	16.29
ADF, %	250	37.45	5.09	32.36	42.54
NDF, %	250	60.83	8.11	52.72	68.94
NNO_3, ppm	47	545.23	598.32		
P, %	33	0.30	0.08	0.22	0.38
K, %	33	1.94	0.67	1.27	2.61
Ca, %	33	0.77	0.27	0.50	1.04
Mg, %	33	0.23	0.07	0.16	0.30
Na, %	30	0.03	0.03	0.00	0.06
S, %	34	0.18	0.04	0.14	0.22
Fe, ppm	21	266.95	169.86	97.39	436.81
Mn, ppm	22	174.73	90.19	84.54	264.92
Cu, ppm	22	9.98	4.15	5.83	14.13
Zn, ppm	22	33.26	11.46	21.80	44.72
TDN, %	277	55.17	5.01	50.16	60.18
RFV,%	250	93.71	19.38	74.33	113.09
Fertilizer Equivalent					
P_2O_5, lb/ton	33	11.58	3.02	8.56	14.60
N, lb/ton	267	35.38	8.74	26.64	44.12
K_2O, lb/ton	33	40.17	13.68	26.49	53.85

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for mixed grass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	5123	87.96	4.64	83.32	92.60
CP, %	5172	11.53	2.98	8.55	14.51
ADF, %	3959	37.38	4.35	33.03	41.73
NDF, %	3959	66.59	5.68	60.91	72.27
NNO_3, ppm	1710	830.64	1133.06		
P, %	563	0.29	0.10	0.19	0.39
K, %	523	1.75	0.56	1.19	2.31
Ca, %	544	0.56	0.19	0.37	0.75
Mg, %	511	0.25	0.07	0.18	0.32
Na, %	332	0.04	0.03	0.01	0.07
S, %	493	0.21	0.06	0.15	0.27
Fe, ppm	380	225.11	168.13	56.98	393.24
Mn, ppm	383	218.94	140.62	78.32	359.56
Cu, ppm	393	10.45	4.21	6.24	14.66
Zn, ppm	379	36.30	15.06	21.24	51.36
TDN, %	5150	53.83	4.45	49.38	58.28
RFV,%	3959	84.37	11.07	73.30	95.44
Fertilizer Equivalent					
P_2O_5, lb/ton	533	11.77	3.87	7.90	15.64
N, lb/ton	5122	32.41	8.45	23.96	40.86
K_2O, lb/ton	504	36.87	11.94	24.93	48.81

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for native grass or weed.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	249	88.13	5.19	82.94	93.32
CP, %	253	10.09	3.66	6.43	13.75
ADF, %	179	38.19	4.63	33.56	42.82
NDF, %	179	65.70	6.37	59.33	72.07
NNO_3, ppm	97	601.91	764.54		
P, %	32	0.24	0.12	0.12	0.36
K, %	33	1.54	0.77	0.77	2.31
Ca, %	32	0.58	0.24	0.34	0.82
Mg, %	31	0.22	0.06	0.16	0.28
Na, %	29	0.02	0.02	0.00	0.04
S, %	34	0.16	0.06	0.10	0.22
Fe, ppm	28	315.43	220.41	95.02	535.84
Mn, ppm	28	275.11	136.74	138.37	411.85
Cu, ppm	29	9.49	5.14	4.35	14.63
Zn, ppm	28	32.81	15.74	17.07	48.55
TDN, %	253	52.69	5.19	47.50	57.88
RFV,%	179	85.05	14.63	70.42	99.68
Fertilizer Equivalent					
P_2O_5, lb/ton	32	9.54	4.68	4.86	14.22
N, lb/ton	249	28.20	9.81	18.39	38.01
K_2O, lb/ton	33	32.65	15.65	17.00	48.30

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for oat.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	22	86.36	5.68	80.68	92.04
CP, %	22	10.28	4.35	5.93	14.63
ADF, %	13	38.57	5.35	33.22	43.92
NDF, %	13	61.62	5.85	55.77	67.47
NNO_3, ppm	10	1778.80	2301.13		
P, %	4	0.20	0.09		
K, %	4	1.51	0.28		
Ca, %	4	0.30	0.14		
Mg, %	4	0.14	0.07		
Na, %	3	0.04	0.03		
S, %	3	0.13	0.06		
Fe, ppm	0	NaN	NA		
Mn, ppm	0	NaN	NA		
Cu, ppm	0	NaN	NA		
Zn, ppm	0	NaN	NA		
TDN, %	21	53.52	4.56	48.96	68.08
RFV,%	13	89.49	9.69	79.80	99.18
Fertilizer Equivalent					
P_2O_5, lb/ton	4	7.69	3.79		
N, lb/ton	22	28.41	11.67	16.74	40.08
K_2O, lb/ton	4	30.76	6.10		

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for orchardgrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	203	87.21	4.74	82.47	91.95
CP, %	205	13.16	3.80	9.36	16.96
ADF, %	127	36.38	4.72	31.66	41.10
NDF, %	127	65.07	6.20	58.87	71.27
NNO_3, ppm	131	1155.69	1247.22		
P, %	22	0.37	0.09	0.28	0.46
K, %	18	2.48	0.57	1.91	3.05
Ca, %	22	0.52	0.20	0.32	0.72
Mg, %	20	0.24	0.06	0.18	0.30
Na, %	13	0.02	0.02	0.00	0.04
S, %	18	0.21	0.05	0.16	0.26
Fe, ppm	12	274.83	213.82	61.01	488.65
Mn, ppm	12	212.42	138.69	73.73	351.11
Cu, ppm	14	11.41	4.66	6.75	16.07
Zn, ppm	12	37.94	15.80	22.14	53.74
TDN, %	201	57.02	4.12	52.90	61.14
RFV,%	127	87.77	13.44	74.33	101.21
Fertilizer Equivalent					
P_2O_5, lb/ton	22	14.47	3.42	11.05	17.89
N, lb/ton	203	36.56	10.42	26.14	46.98
K_2O, lb/ton	18	51.45	13.63	37.82	65.08

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for rye.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	60	86.46	6.69	79.77	93.15
CP, %	62	12.32	4.42	7.90	16.74
ADF, %	47	38.66	5.37	33.29	44.03
NDF, %	47	65.86	6.67	59.19	72.53
NNO_3, ppm	31	848.77	678.85		
P, %	13	0.32	0.09	0.23	0.41
K, %	13	2.16	0.45	1.71	2.61
Ca, %	13	0.49	0.15	0.34	0.64
Mg, %	13	0.17	0.04	0.13	0.21
Na, %	13	0.04	0.03	0.01	0.07
S, %	13	0.18	0.04	0.14	0.22
Fe, ppm	10	156.90	108.69	48.21	265.59
Mn, ppm	10	152.80	71.59	81.21	224.39
Cu, ppm	10	9.89	6.28	3.61	16.17
Zn, ppm	10	42.09	10.05	32.04	52.14
TDN, %	59	54.59	5.67	48.92	60.26
RFV,%	47	84.42	14.49	69.93	98.91
Fertilizer Equivalent					
P_2O_5, lb/ton	13	12.16	3.81	8.35	15.97
N, lb/ton	60	33.86	12.08	21.78	45.94
K_2O, lb/ton	13	42.43	9.42	33.01	51.85

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for ryegrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	341	86.58	5.15	81.43	91.73
CP, %	345	11.62	3.72	7.90	15.34
ADF, %	254	37.51	4.64	32.87	42.15
NDF, %	254	64.32	6.28	58.04	70.60
NNO_3, ppm	120	878.48	1393.18		
P, %	59	0.30	0.09	0.21	0.39
K, %	58	1.92	0.62	1.30	2.54
Ca, %	60	0.53	0.19	0.34	0.72
Mg, %	59	0.19	0.04	0.15	0.23
Na, %	47	0.03	0.02	0.01	0.05
S, %	57	0.20	0.04	0.16	0.24
Fe, ppm	50	222.30	221.39	0.91	443.69
Mn, ppm	51	194.33	104.98	89.35	299.31
Cu, ppm	52	9.97	3.44	6.53	13.41
Zn, ppm	51	36.75	15.21	21.54	51.96
TDN, %	343	55.83	4.01	51.82	59.84
RFV,%	254	87.54	13.48	74.06	101.02
Fertilizer Equivalent					
P_2O_5, lb/ton	59	11.51	3.30	8.21	14.81
N, lb/ton	340	31.82	9.64	22.18	41.46
K_2O, lb/ton	58	39.58	12.83	26.75	52.41

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for sorghum-sudangrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	296	84.18	6.54	77.64	90.72
CP, %	317	11.34	3.58	7.76	14.92
ADF, %	159	37.02	6.03	30.99	43.05
NDF, %	159	63.72	5.50	58.22	69.22
NNO_3, ppm	602	1599.42	1696.83		
P, %	13	0.30	0.11	0.19	0.41
K, %	13	1.79	0.61	1.18	2.40
Ca, %	13	0.65	0.20	0.45	0.85
Mg, %	13	0.29	0.09	0.20	0.38
Na, %	4	0.01	0.00		
S, %	14	0.16	0.04	0.12	0.20
Fe, ppm	8	275.50	194.55	80.95	470.05
Mn, ppm	8	151.25	104.94		
Cu, ppm	9	11.03	3.60		
Zn, ppm	8	37.80	13.20		
TDN, %	311	62.08	6.45	55.63	68.53
RFV,%	159	86.17	14.19	71.98	100.36
Fertilizer Equivalent					
P_2O_5, lb/ton	12	11.09	4.17	6.92	15.26
N, lb/ton	295	30.50	9.17	21.33	39.67
K_2O, lb/ton	12	39.22	8.21	31.01	47.43

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for soybean.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	13	83.22	7.94	75.28	91.16
CP, %	13	14.10	4.49	9.61	18.59
ADF, %	11	37.41	9.24	28.17	46.65
NDF, %	11	52.20	10.75	41.45	62.95
NNO_3, ppm	3	636.00	751.71		
P, %	0				
K, %	0				
Ca, %	0				
Mg, %	0				
Na, %	0				
S, %	0				
Fe, ppm	0				
Mn, ppm	0				
Cu, ppm	0				
Zn, ppm	0				
TDN, %	12	57.22	5.59	51.63	62.81
RFV,%	11	112.21	31.71	80.50	143.92
Fertilizer Equivalent					
P_2O_5, lb/ton	0				
N, lb/ton	13	38.04	13.64	24.40	51.68
K_2O, lb/ton	0				

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Table of nutrient composition results for wheat.

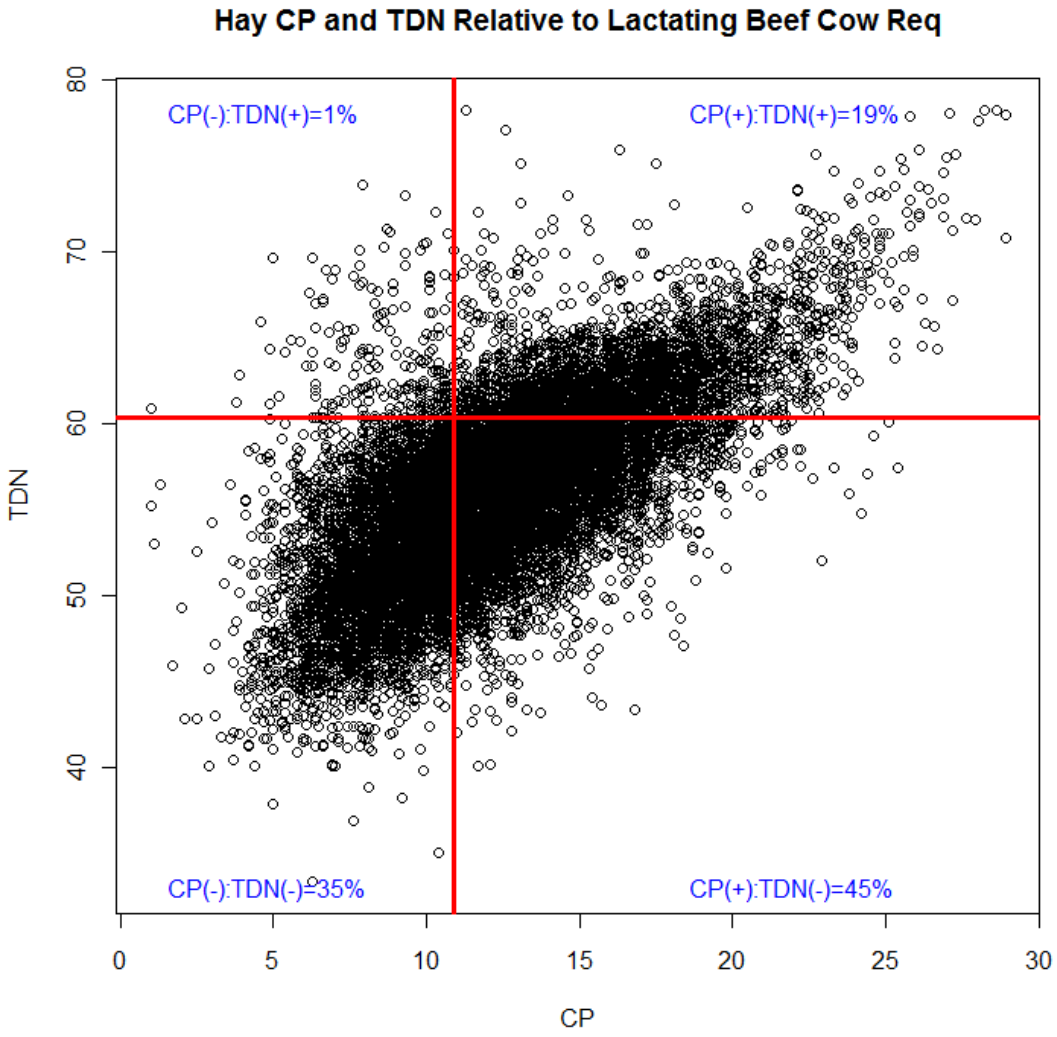
	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	101	86.44	5.71	80.73	92.15
CP, %	102	11.15	3.52	7.63	14.67
ADF, %	67	36.24	5.11	31.13	41.35
NDF, %	67	62.17	6.51	55.66	68.68
NNO_3, ppm	59	1050.68	1026.93		
P, %	7	0.38	0.09		
K, %	7	2.13	0.60		
Ca, %	7	0.47	0.15		
Mg, %	7	0.18	0.03		
Na, %	6	0.03	0.02		
S, %	7	0.19	0.04		
Fe, ppm	7	245.57	250.58		
Mn, ppm	7	130.43	122.86		
Cu, ppm	7	8.83	1.88		
Zn, ppm	7	33.80	5.46		
TDN, %	98	55.23	4.04	51.19	59.27
RFV,%	67	92.15	13.88	78.27	106.03
Fertilizer Equivalent					
P_2O_5, lb/ton	7	15.11	4.66		
N, lb/ton	101	30.92	10.27	20.65	41.19
K_2O, lb/ton	7	45.14	15.24		

Fertilizer equivalent per ton as-is basis.

Normal ranges were excluded for n ≤ 10.

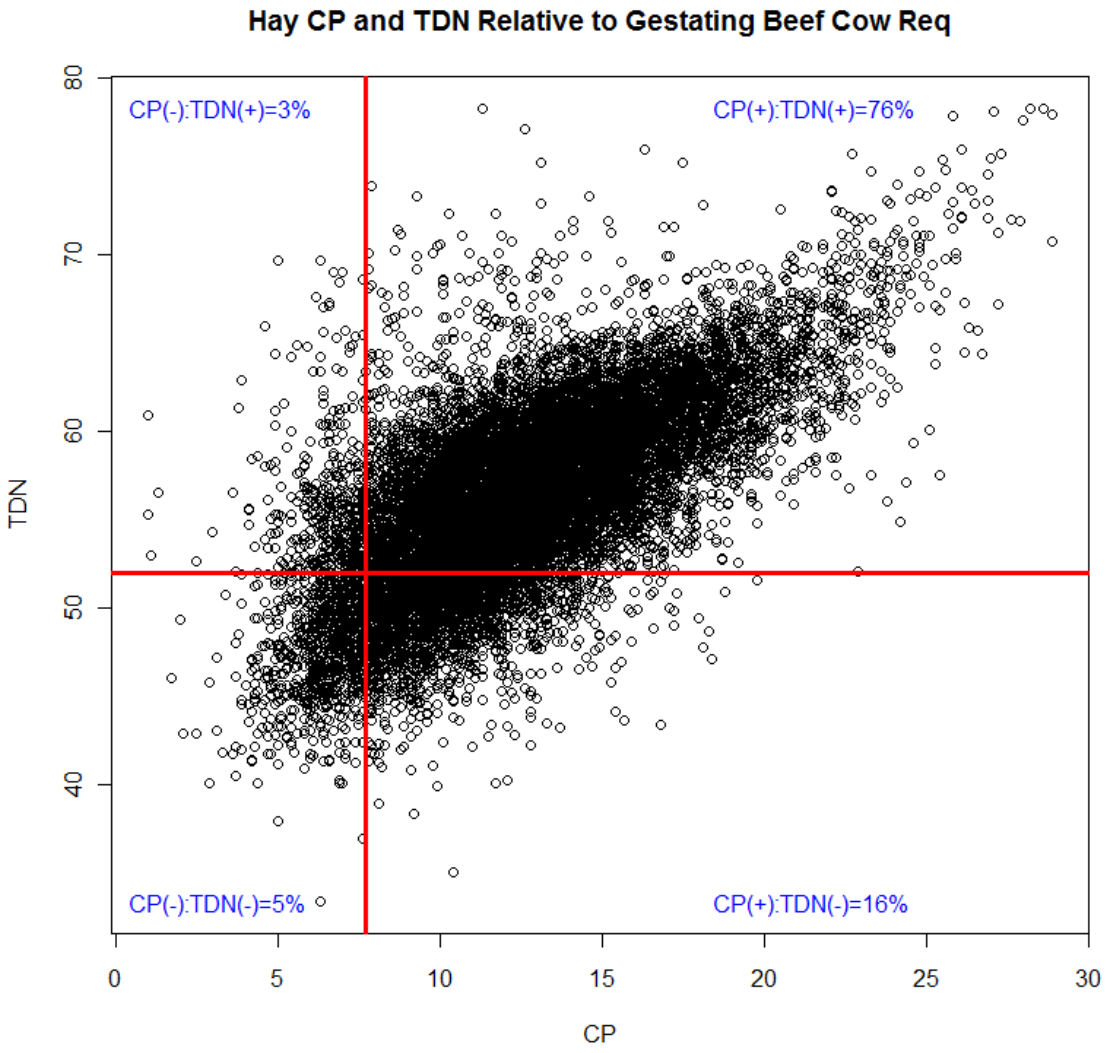
Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Hay summary: Graphical representation of hay samples relative to beef cow requirements for CP and TDN during early lactation.



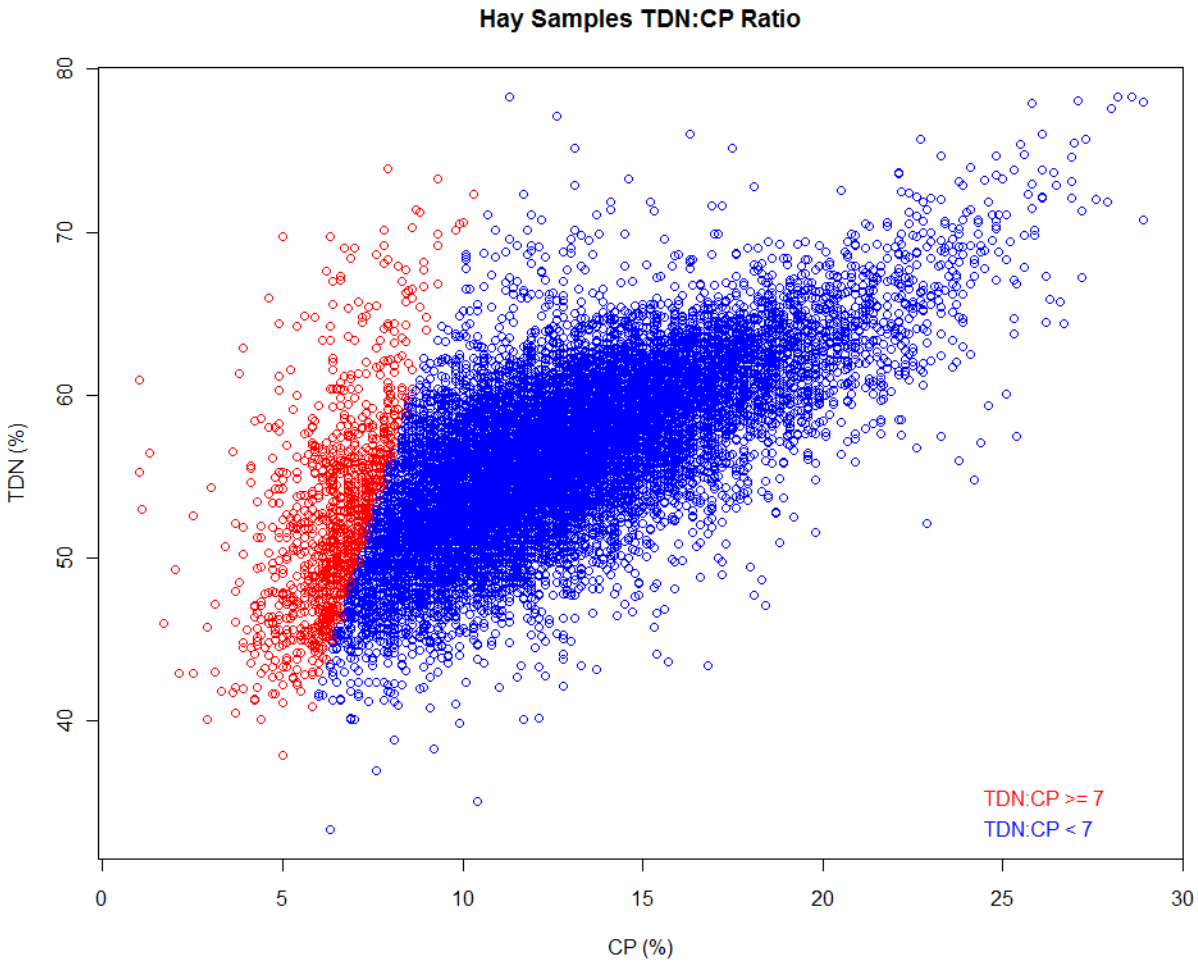
Summary statement: Overall, 19% of hay samples appear sufficient in quality to meet CP and TDN requirements in early lactation. Thirty-five percent are both CP- and TDN-deficient. Protein supplementation alone would be adequate for 1% of the samples; TDN supplementation alone would be adequate for 45% of the samples. Cumulatively, 36% are CP-deficient and 80% TDN-deficient (chi square test, $P < 0.001$).

Hay summary: Graphical representation of hay samples relative to beef cow requirements for CP and TDN during late-gestation.



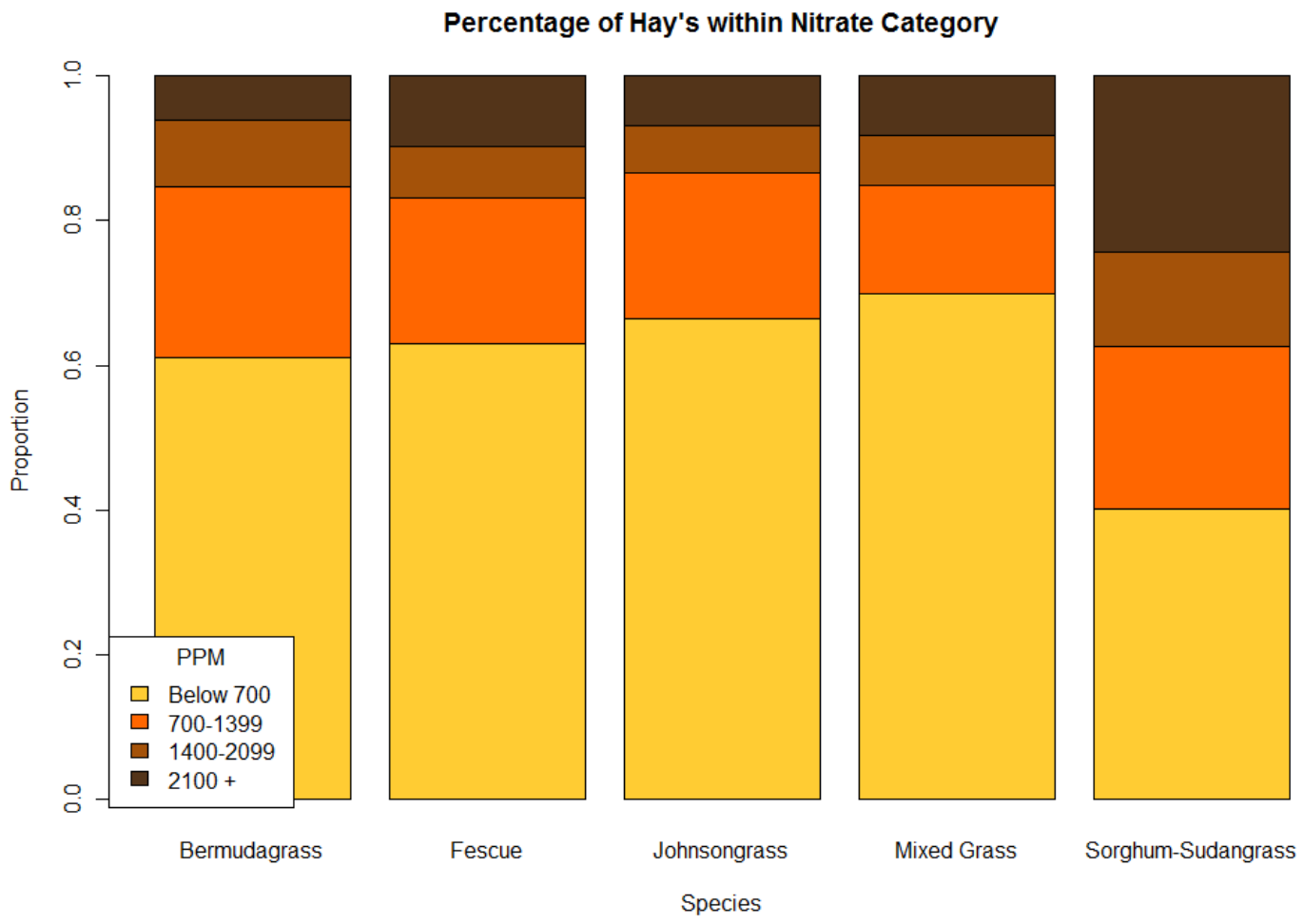
Summary statement: Overall, 76% of hay samples appear sufficient in quality to meet CP and TDN requirements in late-gestation. Five percent are both CP- and TDN-deficient. Protein supplementation alone would be adequate for 3% of the samples; TDN supplementation alone would be adequate for 16% of the samples. Cumulatively, 8% are CP-deficient and 21% TDN-deficient (chi square test, $P < 0.001$).

Hay summary: Graphical representation of hay sample ratio of TDN:CP.



Summary statement: Hay TDN:CP is indicative to the type of response in forage intake observed when supplemental protein feeds are provided. When low-level supplementation is provided with forages that have a TDN:CP ratio ≥ 7, forage intake is expected to increase. When supplemental feed is offered with forages that have a TDN:CP ratio < 7, forage intake is expected to decrease. Seven percent of all hays have an estimated TDN:CP ≥ 7; while 93% have a TDN:CP < 7.

Hay summary: Proportion of hay samples within species quantified into the four common NNO_3 management categories.



(chi square test, $P < 0.001$)

Hay summary: Two-variable sensitivity table showing the 95% confidence limits for the predicted probability of observing nitrate-N at a dangerously high level (> 1400 ppm NNO_3).

Forage type[a] 95% confidence limits[b]								
	WSG		CSG		MIX		NIT	
Forage CP	lower (%)	upper (%)	lower (%)	upper (%)	lower (%)	upper (%)	lower (%)	upper (%)
10%	1.3	2.3	1.8	3.6	1.4	2.6	11.3	19.6
12%	2.7	4.3	3.6	6.9	3.0	5.1	21.0	32.9
14%	5.6	7.9	7.2	12.8	5.9	9.6	35.1	50.1
16%	11.1	14.5	13.6	22.9	11.3	17.7	52.0	67.6
18%	20.0	25.5	24.0	38.0	20.1	30.7	68.3	81.6
20%	32.9	41.5	38.6	56.3	33.1	48.2	80.9	90.6

[a]WSG, warm-season grass; CSG, cool-season grass; LEG, legume; MIX, mixed grass; and NIT, nitrate-accumulating grasses.
[b]Lower and upper 95% confidence limits (calculated from normal probability distribution).
[c]Negative lower confidence limits were suppressed to zero.

Example: A bermudagrass hay sample is a warm-season grass. It tested 16% CP (DM basis). With 90% confidence, the chance of this hay containing 1,400 ppm NNO_3 or greater is 11.1% to 14.5%. If the sample had been a sorghum-sudan grass (nitrate-accumulating specie) sample, the probability of the sample containing a dangerously high nitrate level would be 52.0% to 67.6%.

Table of Nutrient Composition for Poultry Litter

Litter summary: Table of nutrient composition results for breeder hen litter.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	47	74.85	12.94	61.91	87.79
CP, %	46	17.76	5.78	11.98	23.54
ADF, %	46	28.48	12.18	16.30	40.66
NDF, %	12	33.47	8.16		
NNO_3, ppm					
P, %	17	1.67	0.48	1.19	2.15
K, %	17	2.57	0.96	1.61	3.53
Ca, %	15	4.64	2.59	2.05	7.23
Mg, %	15	0.86	0.77	0.09	1.63
Na, %					
S, %	15	0.58	0.26	0.32	0.84
Fe, ppm	11	1511.91	481.59	30.32	2993.50
Mn, ppm	11	622.18	244.30	377.88	866.48
Cu, ppm	11	493.79	118.34	375.45	612.13
Zn, ppm	11	467.51	189.97	277.54	657.48
TDN, %	46	48.28	6.58	41.70	54.86
Fertilizer Equivalent					
P_2O_5, lb/ton	17	55.89	14.67	41.22	70.56
N, lb/ton	46	43.26	18.16	25.10	61.42
K_2O, lb/ton	17	47.38	20.30	27.08	67.68

Fertilizer equivalent per ton as-is basis.

TDN estimated from broiler litter TDN equation.

Litter summary: Table of nutrient composition results for broiler litter.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	429	77.90	7.84	70.06	85.74
CP, %	426	23.38	4.38	19.00	27.76
ADF, %	425	26.44	7.74	18.70	34.18
NDF, %	202	38.48	7.02	31.46	45.50
NNO_3, ppm	44	738.41	1143.32		
P, %	97	1.62	0.49	1.13	2.11
K, %	91	2.77	0.63	2.14	3.40
Ca, %	88	2.87	0.68	2.19	3.55
Mg, %	79	0.72	0.49	0.23	1.21
Na, %	43	0.76	0.32	0.44	1.08
S, %	72	0.80	0.28	0.54	1.08
Fe, ppm	56	549.05	759.92		
Mn, ppm	56	699.38	141.35	558.03	840.73
Cu, ppm	61	536.93	226.78	310.15	763.71
Zn, ppm	55	485.71	178.68	307.03	664.39
TDN, %	420	49.28	5.68	43.60	54.96
Fertilizer Equivalent					
P_2O_5, lb/ton	79	59.24	18.86	40.38	78.10
N, lb/ton	426	58.47	13.17	45.30	71.64
K_2O, lb/ton	73	52.40	11.68	40.72	64.08

Fertilizer equivalent per ton as-is basis.

Normal ranges excluded for NNO_3 because of large SD relative to the mean.

Litter summary: Table of nutrient composition results for pullet litter.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	29	77.72	5.96	71.76	83.68
CP, %	29	15.76	4.31	11.45	20.07
ADF, %	29	36.62	10.42	26.20	47.04
NDF, %	20	48.94	11.43	37.51	60.37
NNO_3, ppm					
P, %					
K, %					
Ca, %					
Mg, %					
Na, %					
S, %					
Fe, ppm					
Mn, ppm					
Cu, ppm					
Zn, ppm					
TDN, %	29	53.31	4.33	48.98	57.64
Fertilizer Equivalent					
P_2O_5, lb/ton					
N, lb/ton	29	39.16	11.24	27.92	50.40
K_2O, lb/ton					

Fertilizer equivalent per ton as-is basis.

TDN estimated from broiler litter TDN equation.

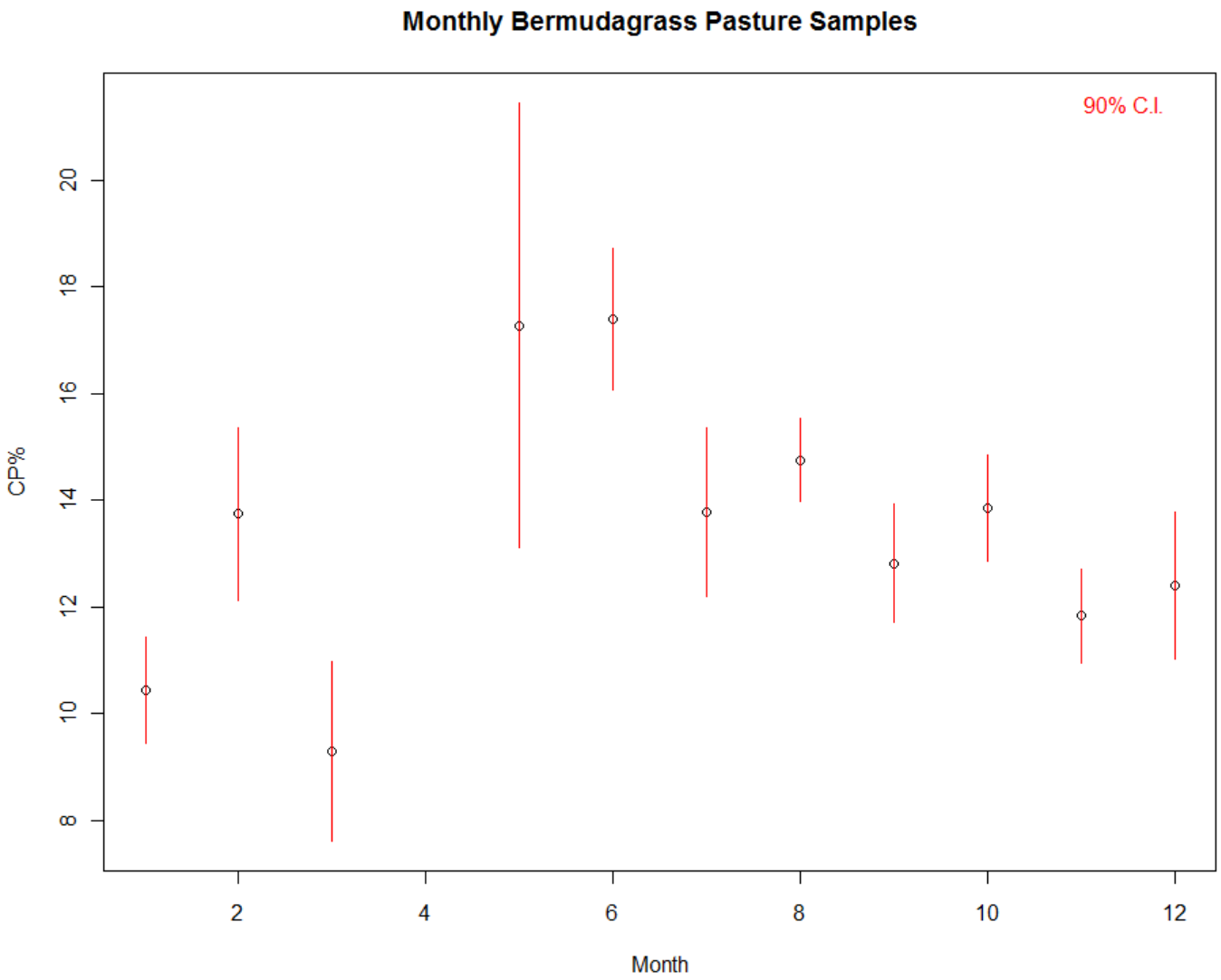
Litter summary: Turkey

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	44	72.47	11.03	61.44	83.50
CP, %	44	20.58	5.83	14.75	26.41
ADF, %	44	36.23	10.96	25.27	47.19
NDF, %	14	44.34	7.47	36.87	51.81
NNO_3, ppm					
P, %					
K, %					
Ca, %					
Mg, %					
Na, %					
S, %					
Fe, ppm					
Mn, ppm					
Cu, ppm					
Zn, ppm					
TDN, %	44	52.84	4.19	48.65	57.03
Fertilizer Equivalent					
P_2O_5, lb/ton					
N, lb/ton	44	48.08	15.39	32.69	63.47
K_2O, lb/ton					

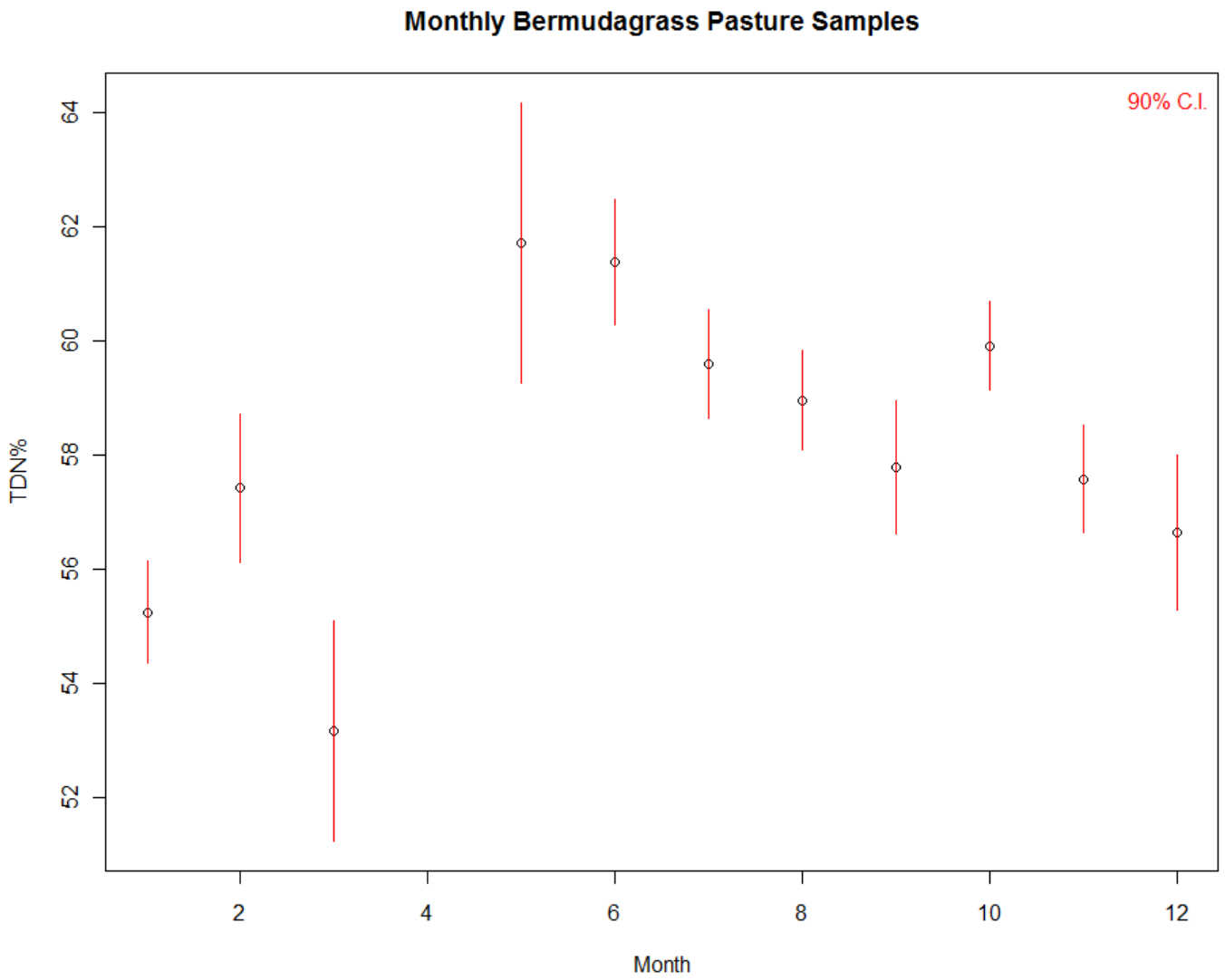
Fertilizer equivalent per ton as-is basis.

TDN estimated from broiler litter TDN equation.

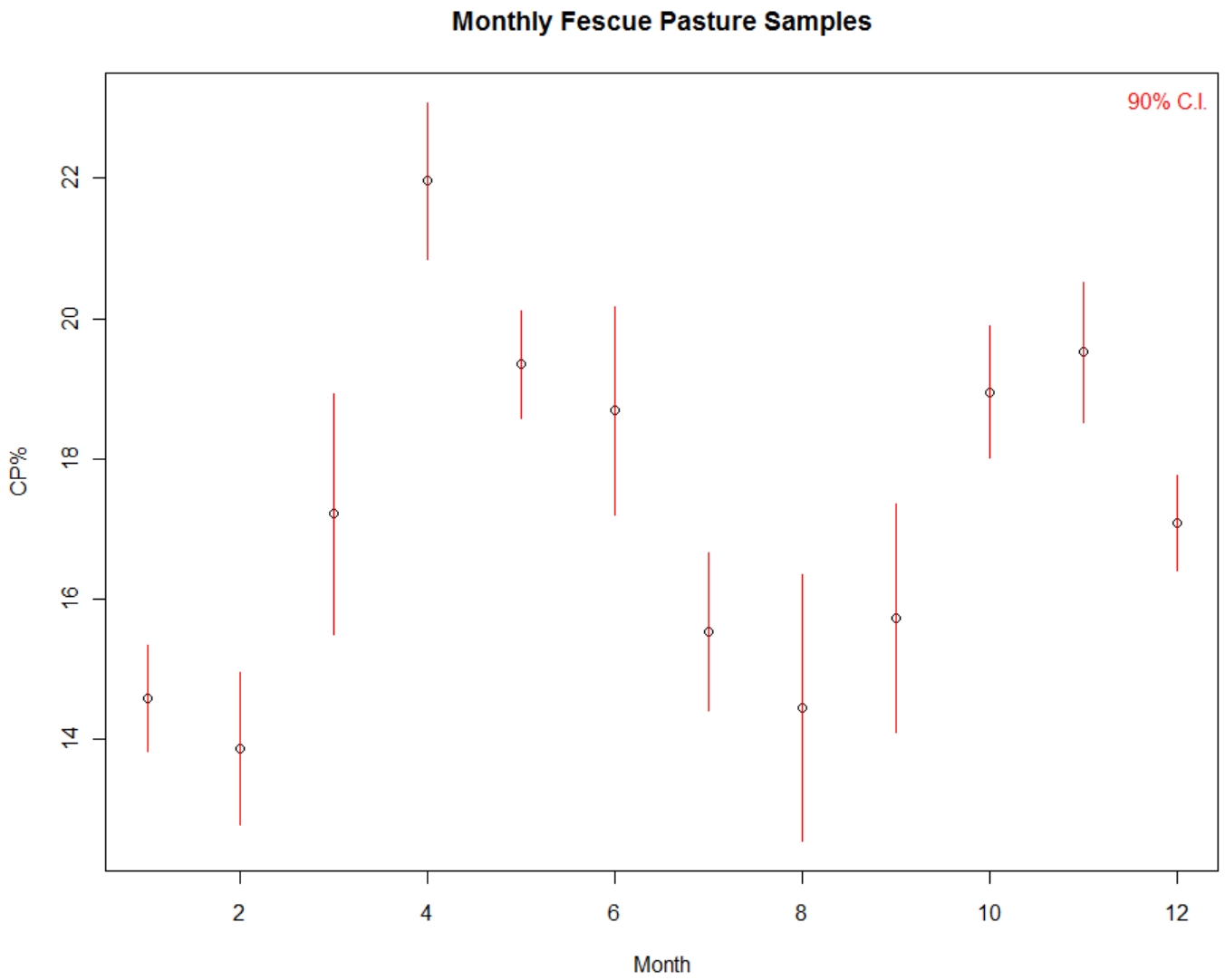
Pasture summary: Monthly bermudagrass CP average and 90% CI.



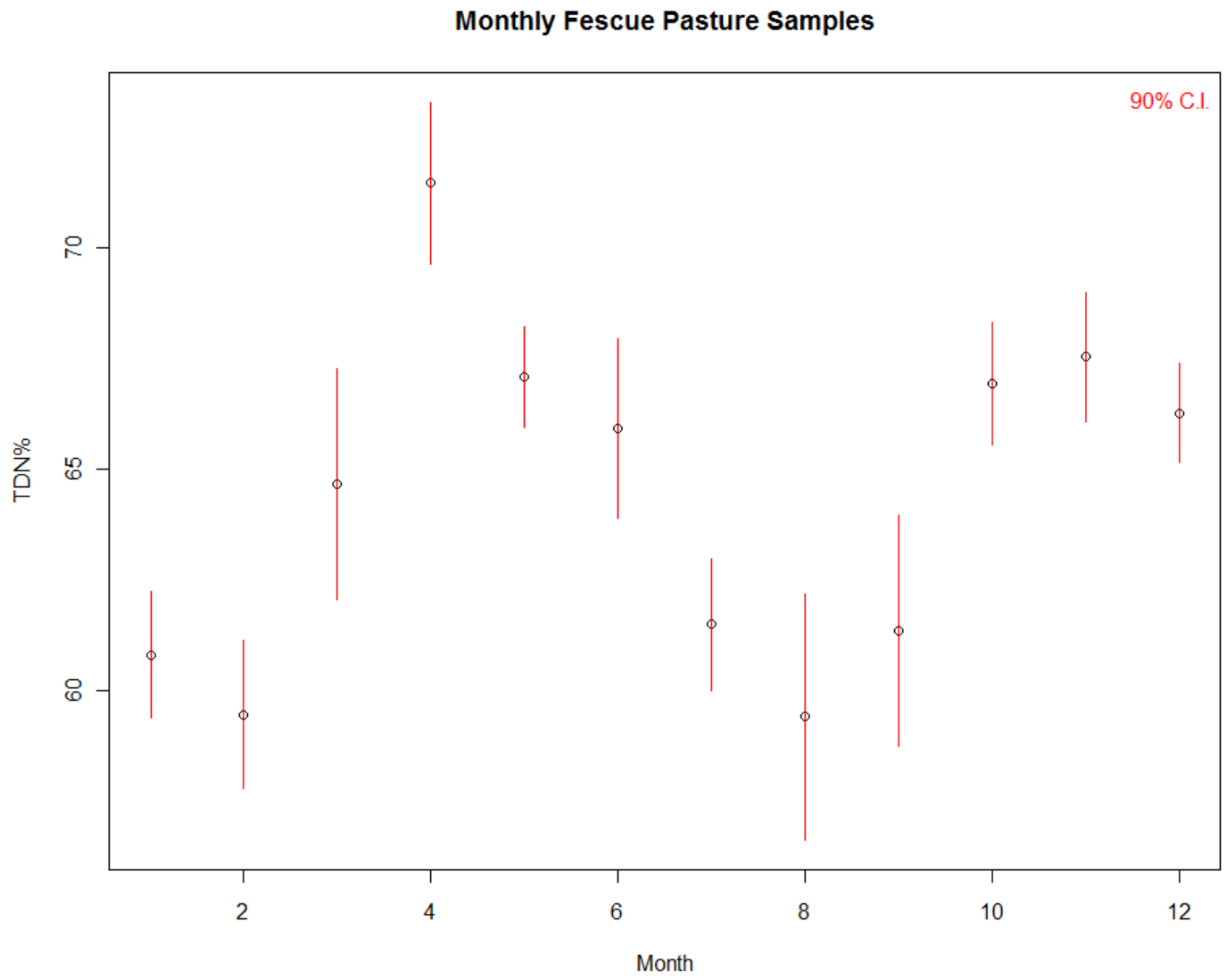
Pasture summary: Monthly bermudagrass TDN average and 90% CI.



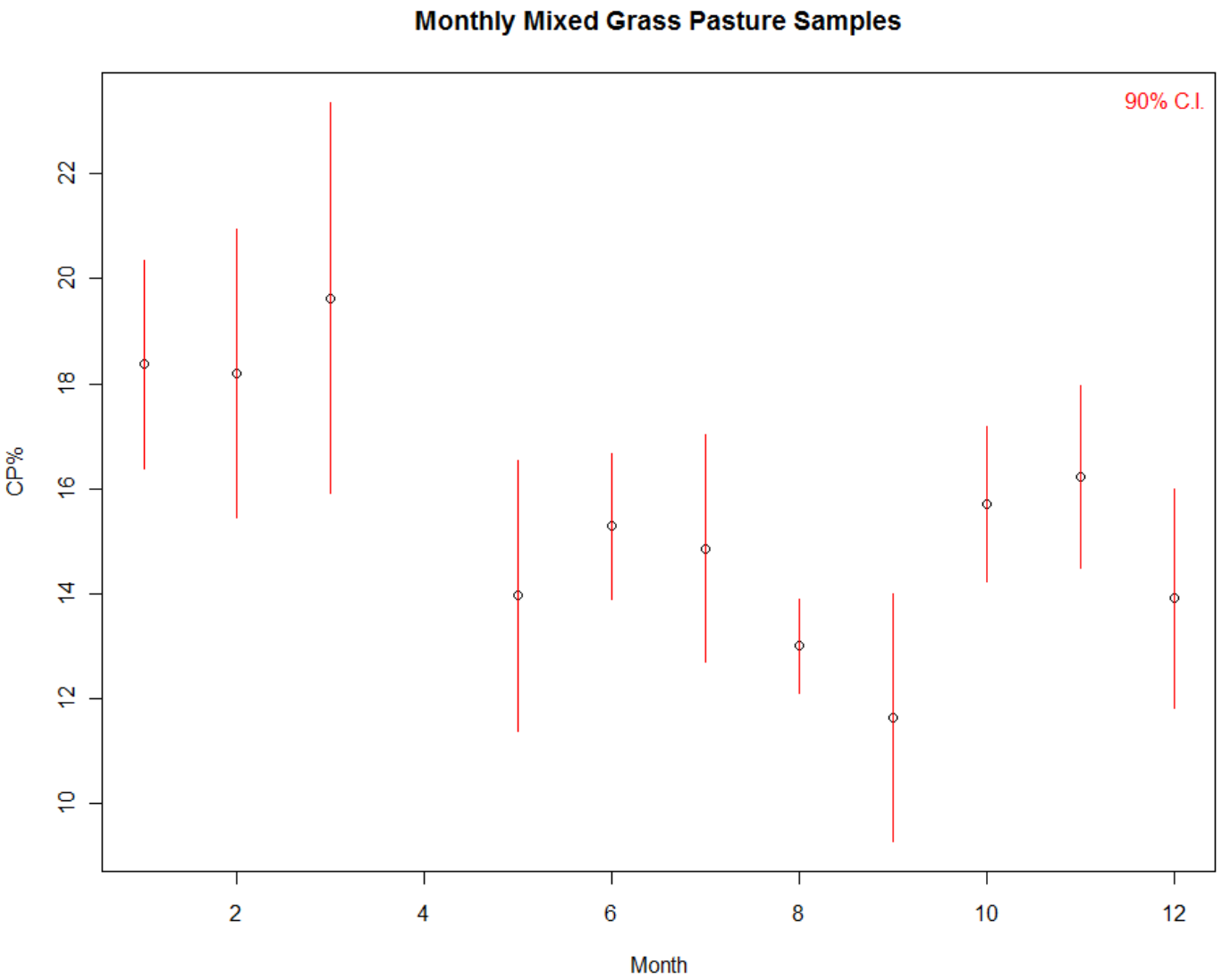
Pasture summary: Monthly fescue CP average and 90% CI.



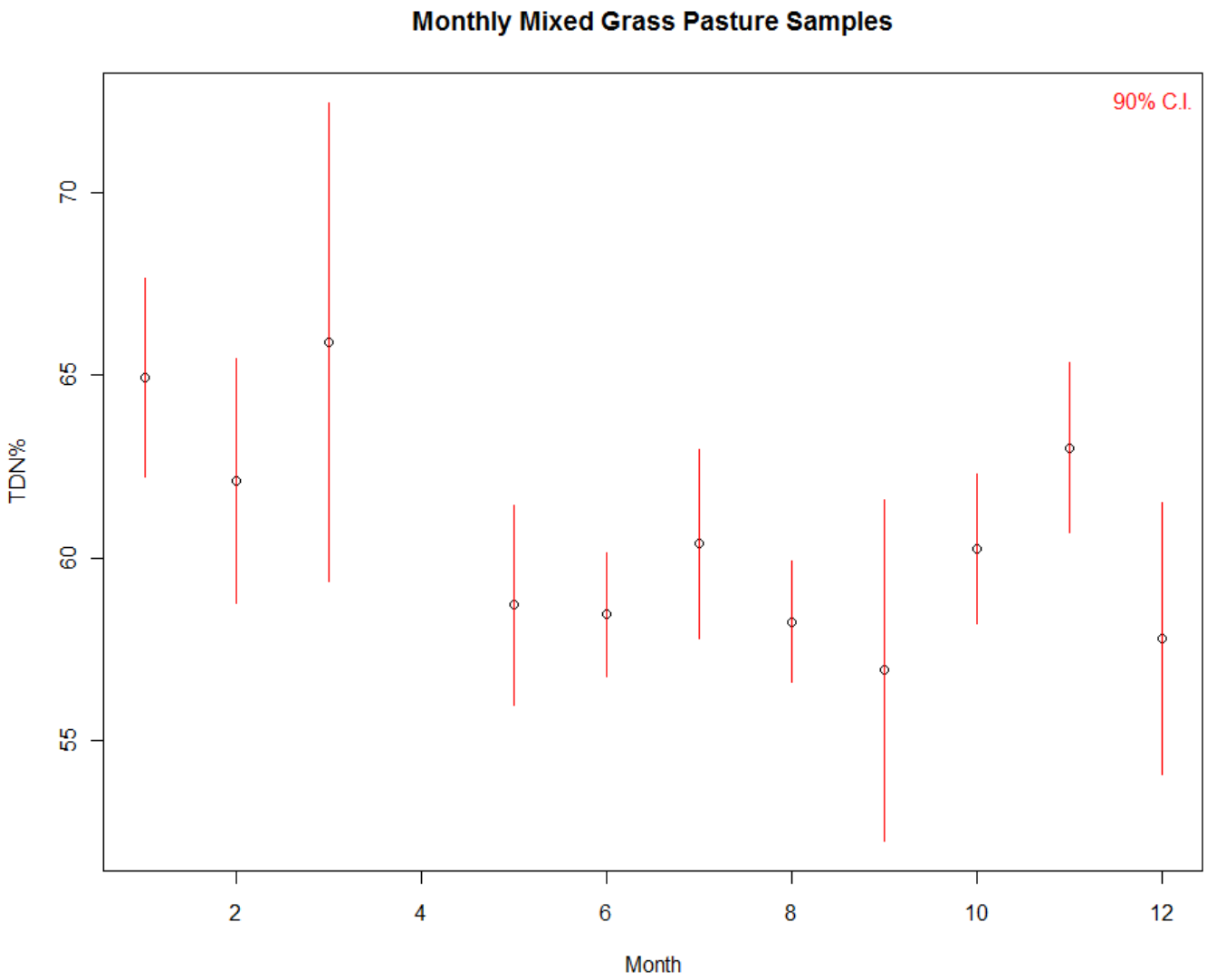
Pasture summary: Monthly fescue TDN average and 90% CI.



Pasture summary: Monthly mixed grass CP average and 90% CI.



Pasture summary: Monthly mixed grass TDN average and 90% CI.



Pasture summary: Summary table of pasture sample CP analysis.

Species	Month	n	Mean	SD	min	max	Lower 90% CI	Upper 90% CI
Bermudagrass	1	25	10.5	3.02	5.5	15.6	9.5	11.4
Bermudagrass	2	25	13.8	4.91	5.4	23.6	12.1	15.4
Bermudagrass	3	12	9.3	3.53	5.2	19.5	7.6	11.0
Bermudagrass	5	4	17.3	5.06	12.4	21.8	13.1	21.4
Bermudagrass	6	22	17.4	3.77	9.4	24.7	16.1	18.7
Bermudagrass	7	19	13.8	4.18	7.4	20.2	12.2	15.4
Bermudagrass	8	52	14.8	3.36	5.8	21.9	14.0	15.5
Bermudagrass	9	31	12.8	3.75	6.4	19.3	11.7	13.9
Bermudagrass	10	52	13.9	4.32	6.1	24.3	12.9	14.8
Bermudagrass	11	45	11.8	3.59	5.3	21.4	11.0	12.7
Bermudagrass	12	29	12.4	4.52	5.8	23.8	11.0	13.8
Fescue	1	68	14.6	3.78	6.8	23	13.8	15.3
Fescue	2	27	13.9	3.44	10	24.3	12.8	15.0
Fescue	3	30	17.2	5.69	9.2	26.9	15.5	18.9
Fescue	4	24	22.0	3.31	14.6	27.2	20.9	23.1
Fescue	5	34	19.3	2.69	14.2	25.8	18.6	20.1
Fescue	6	22	18.7	4.24	11.3	28.3	17.2	20.2
Fescue	7	22	15.5	3.19	11.1	23.5	14.4	16.7
Fescue	8	21	14.4	5.27	7.8	27.8	12.5	16.3
Fescue	9	18	15.7	4.2	9.2	22.8	14.1	17.4
Fescue	10	56	19.0	4.26	9.9	27.4	18.0	19.9
Fescue	11	50	19.5	4.32	12.3	29.1	18.5	20.5
Fescue	12	72	17.1	3.45	10.3	24.1	16.4	17.8
Mixed Grass	1	20	18.4	5.38	8.7	28.8	16.4	20.4
Mixed Grass	2	5	18.2	3.74	13.9	23.4	15.4	21.0
Mixed Grass	3	7	19.6	5.99	13.1	28.6	15.9	23.4
Mixed Grass	5	9	14.0	4.69	8.6	21.2	11.4	16.5
Mixed Grass	6	22	15.3	3.96	8.7	23.2	13.9	16.7
Mixed Grass	7	13	14.9	4.72	9.7	25.3	12.7	17.0
Mixed Grass	8	9	13.0	1.63	11.2	15.9	12.1	13.9
Mixed Grass	9	6	11.6	3.5	8.4	16.2	9.3	14.0
Mixed Grass	10	22	15.7	4.18	4.8	23.6	14.2	17.2
Mixed Grass	11	29	16.2	5.68	6.7	25.7	14.5	18.0
Mixed Grass	12	16	13.9	5.08	8.3	25.9	11.8	16.0

Pasture summary: Summary table of pasture sample TDN analysis.

Species	Month	n	mean	sd	min	max	Lower 90% CI	Upper 90% CI
Bermudagrass	1	25	55.2	2.72	48.3	60.6	54.4	56.1
Bermudagrass	2	25	57.4	3.96	49.4	65.2	56.1	58.7
Bermudagrass	3	12	53.2	4.05	46.4	62.4	51.2	55.1
Bermudagrass	5	4	61.7	2.98	58.9	65.8	59.3	64.2
Bermudagrass	6	21	61.4	3.04	55.9	66.5	60.3	62.5
Bermudagrass	7	19	59.6	2.5	56.5	64.4	58.7	60.5
Bermudagrass	8	52	59.0	3.77	49.0	65.7	58.1	59.8
Bermudagrass	9	31	57.8	3.94	51.5	65.5	56.6	59.0
Bermudagrass	10	52	59.9	3.37	51.2	66.5	59.1	60.7
Bermudagrass	11	44	57.6	3.8	48.1	66.6	56.6	58.5
Bermudagrass	12	29	56.6	4.43	49.4	64.7	55.3	58.0
Fescue	1	68	60.8	7.18	31.6	73.0	59.4	62.2
Fescue	2	27	59.4	5.26	51.9	69.6	57.8	61.1
Fescue	3	30	64.7	8.74	50.9	78.7	62.0	67.3
Fescue	4	24	71.5	5.44	62.2	79.2	69.6	73.3
Fescue	5	34	67.1	4.04	59.0	76.8	66.0	68.2
Fescue	6	22	65.9	5.79	53.9	78.0	63.9	68.0
Fescue	7	22	61.5	4.27	54.5	72.5	60.0	63.0
Fescue	8	21	59.4	7.76	49.7	79.1	56.6	62.2
Fescue	9	18	61.3	6.76	51.2	73.7	58.7	64.0
Fescue	10	54	66.9	6.18	52.6	78.4	65.6	68.3
Fescue	11	47	67.5	6.09	54.1	77.9	66.1	69.0
Fescue	12	72	66.3	5.83	51.7	76.5	65.1	67.4
Mixed Grass	1	20	64.9	7.39	49.2	77.3	62.2	67.7
Mixed Grass	2	5	62.1	4.56	55.4	66.7	58.8	65.5
Mixed Grass	3	8	65.9	11.29	47.6	78.6	59.3	72.5
Mixed Grass	5	9	58.7	5	54.7	66.8	56.0	61.4
Mixed Grass	6	22	58.4	4.85	51.8	70.6	56.7	60.1
Mixed Grass	7	13	60.4	5.65	53.6	72.6	57.8	63.0
Mixed Grass	8	8	58.2	2.85	54.3	62.9	56.6	59.9
Mixed Grass	9	6	56.9	6.97	48.5	64.8	52.2	61.6
Mixed Grass	10	22	60.3	5.84	42.5	72.7	58.2	62.3
Mixed Grass	11	29	63.0	7.62	48.7	77.8	60.7	65.3
Mixed Grass	12	16	57.8	9.05	48.1	76.3	54.0	61.5

Summary statement: Pasture samples from October through March include stockpiled forage samples. The TDN composition of samples submitted from May through November may be slightly greater and CP slightly lesser in content than the values represented due to sample collection, handling, storage and shipping prior to analysis. As fresh forage samples wilt, plant respiration will burn soluble carbohydrates, resulting in a loss of energy during from collection to analysis.

Silage summary: Table of nutrient composition results for bermudagrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	40	45.38	13.91	31.47	59.29
CP, %	40	12.86	3.04	9.82	15.90
ADF, %	40	37.30	5.49	31.81	42.79
NDF, %	40	65.83	7.89	57.94	73.72
TDN, %	40	53.43	5.47	47.96	58.90
RFV,%	40	86.12	14.60	71.52	100.72

Silage summary: Table of nutrient composition results for corn.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	117	37.61	11.52	26.09	49.13
CP, %	109	8.97	1.76	7.21	10.73
ADF, %	108	28.10	6.56	21.54	34.66
NDF, %	78	47.76	9.77	37.99	57.53
TDN, %	109	64.36	7.51	56.85	71.87
RFV,%	78	137.92	37.42	100.50	175.34

Silage summary: Table of nutrient composition results for fescue.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	20	43.23	12.99	30.24	56.22
CP, %	20	13.46	3.30	10.16	16.76
ADF, %	20	34.56	4.89	29.67	39.45
NDF, %	16	60.05	3.77	56.28	63.82
TDN, %	20	57.81	4.25	53.56	62.06
RFV,%	16	97.72	7.85	89.87	105.57

Silage summary: Table of nutrient composition results for mixed grass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	67	43.46	14.68	28.78	58.14
CP, %	68	12.23	2.73	9.50	14.96
ADF, %	63	35.66	6.00	29.66	41.66
NDF, %	55	59.13	7.09	52.04	66.22
TDN, %	63	55.39	5.95	49.44	61.34
RFV,%	55	99.15	15.82	83.33	114.97

Silage summary: Table of nutrient composition results for ryegrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	27	44.36	22.47	21.89	66.83
CP, %	27	12.23	3.98	8.25	16.21
ADF, %	27	33.74	6.11	27.63	39.85
NDF, %	23	56.97	9.14	47.83	66.11
TDN, %	27	58.40	3.51	54.89	61.91
RFV,%	23	106.37	29.14	77.23	135.51

Silage summary: Table of nutrient composition results for sorghum-silage.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	107	40.76	20.00	20.76	60.76
CP, %	107	9.60	3.90	5.70	13.50
ADF, %	106	37.18	7.91	29.27	45.09
NDF, %	57	62.55	5.26	57.29	67.81
TDN, %	105	52.61	6.45	46.16	59.06
RFV,%	57	85.89	14.84	71.05	100.73

Silage summary: Table of nutrient composition results for sorghum-sudangrass.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	56	33.04	11.77	21.27	44.81
CP, %	55	10.48	3.07	7.41	13.55
ADF, %	55	37.30	9.85	27.45	47.15
NDF, %	37	62.50	7.34	55.16	69.84
TDN, %	53	60.17	7.41	52.76	67.58
RFV,%	37	90.47	23.45	67.02	113.92

Silage summary: Table of nutrient composition results for wheat.

	n	Mean	SD	Normal Range (± 1 SD)	
DM, %	43	35.11	10.98	24.13	46.09
CP, %	31	12.84	3.17	9.67	16.01
ADF, %	31	37.38	6.18	31.20	43.56
NDF, %	20	57.47	7.31	50.16	64.78
TDN, %	31	55.36	5.59	49.77	60.95
RFV,%	20	100.41	21.06	79.35	121.47

Summary statement: Silage dry matter values are influenced by sample collection, handling and shipment, and therefore may not adequately reflect the actual moisture content of silages sampled.

Statement of Analysis

Graphical and tabular data and statistical analyses presented in this publication were generated using R statistical software (http://www.r-project.org/) version 2.12.2. Additional packages used include maptools (version 0.8-7), rgeos (0.1-7), classInt (version 0.1-14) and psych (version 1.0-98).

Appendix A. Feed sample submission form.

UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE

Agricultural Diagnostic Service Laboratory
University of Arkansas
(479) 575-3908

AGRI-412
Rev. 4-6-2009

FEED INFORMATION SHEET
For Forages, Litters, Grains, and other Livestock Feeds

Name _____ County _____

Rt. Or Street _____

City _____ State _____ Zip Code _____

LAB USE ONLY
Lab. No. _____
Date Received _____

A. Test Desired

☐ Routine (moisture, % C.P., ADF, NDF, TDN, NEL).....	$ 18.00	Analysis Fees _____
☐ Forage Nitrate.....	$ 5.00	
☐ Major Minerals (P, K, Ca, Mg, Na, S)	$ 6.00	Postage Fees _____
☐ Minor Minerals (Fe, Mn, Zn, Cu)	$ 6.00	
☐ Acid Detergent Indigestible Nitrogen.....	$ 8.00	Total Fees* _____
☐ Silage pH.....	$ 3.00	*Out-of-State samples add 20% to fees.

Individual Minerals: $1.50 each

☐ Phosphorus ☐ Magnesium ☐ Iron ☐ Copper
☐ Potassium ☐ Sodium ☐ Manganese ☐ Boron
☐ Calcium ☐ Sulfur ☐ Zinc ☐ Relative Feed Value
☐ Special Instructions _____

Send sample, check and form to:
UA Agri Service Lab
1366 West Altheimer Drive
Fayetteville, AR 72704

B. Sample Information: Sample No. _____ Date Sampled _____ Shipped _____

Feed # from list below* _____ (necessary for TDN) _____ Variety _____

Type of Sample (check one) ☐ Hay ☐ Pasture ☐ Silage ☐ Litter ☐ Grain ☐ Other _____

***IMPORTANT**: Select only *one* feed # from the list below which best describes this sample. For mixtures, choose the predominate forage, if possible, or choose "Mixed Grass" (#13.)

FEED # LIST

Forages
1. Alfalfa
2. Alfalfa-Grass Mixture
3. Bahiagrass
4. Bermudagrass
5. Bluestems
6. Bromegrass
7. Clover
8. Corn Silage
9. Dallisgrass
10. Fescue
11. Johnsongrass
12. Legume-Grass Mixture
13. Mixed Grass
14. Native Grass or Weed
15. Oat
16. Orchardgrass
17. Rye
18. Ryegrass
19. Sorghum-Sudangrass
20. Sorghum-Grain Type
21. Sorghum-Silage Type
22. Soybean
23. Straw of Small Grain
24. Triticale
25. Wheat
26. Matuagrass

Poultry Litters
* 30. Breeder Hen
31. Broiler
* 32. Pullet
* 33. Turkey

Others
* 35. Cottonseed
* 36. Soybeans
* 37. None of the above

Grains
40. Corn
** 41. Mixed Grains
42. Sorghum
43. Wheat, Oats, Rye

* TDN not available for these species.
** TDN not available or inaccurate if sample contains by-product or high fat feedstuffs.

Prices listed are current as of 9/1/05. Prices are subject to change without notice.

Send three copies to lab. One copy will be returned with sample Results for producer's records.

Appendix B. Forage and feed identification numbers and TDN equations.

CES-437
(7-98)

UofA UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE Cooperative Extension Service

Forage or Feed Identification Numbers and TDN Equations

Abbreviations used:
TDN = Total Digestible Nutrients
CP = Crude Protein
ADF = Acid Detergent Fiber
NDF = Neutral Detergent Fiber
EDP = Estimated Digestible Protein (dry matter basis) = .836 (%CP, dry matter basis) - 2.65

Category	Species ID No.	Species	Formulas to Calculate TDN on a Dry Matter Basis (All values expressed on a dry matter basis)
Forages	1.	Alfalfa	73.5 + 0.62(%CP) – 0.71(%ADF)
	2.	Alfalfa-grass mixture	73.5 + 0.62(%CP) – 0.71(%ADF)
	3.	Bahiagrass	111.8 + 0.95(%CP) – 0.36(%ADF) – 0.7(%NDF)
	4.	Bermudagrass	111.8 + 0.95(%CP) – 0.36(%ADF) – 0.7(%NDF)
	5.	Bluestems	111.8 + 0.95(%CP) – 0.36(%ADF) – 0.7(%NDF)
	6.	Bromegrass	87.1 – 0.83(%ADF)
	7.	Clover	73.5 + 0.62(%CP) – 0.71 (%ADF)
	8.	Corn silage	85.5 – 0.75(%ADF)
	9.	Dallisgrass	111.8 + 0.95(%CP) – 0.36(%ADF) – 0.7(%NDF)
	10.	Fescue	58.4 + 1.034(%CP) – 0.42(%ADF)
	11.	Johnsongrass	101.5 – 0.10(%EDP) – 1.02(%ADF)
	12.	Legume-grass mixtures	73.5 + 0.62(%CP) – 0.71(%ADF)
	13.	Mixed grass	73.5 + 0.62(%CP) – 0.71(%ADF)
	14.	Native Grass or Weeds	73.5 + 0.62(%CP) – 0.71(%ADF)
	15.	Oat	73.5 + 0.62(%CP) – 0.71(%ADF)
	16.	Orchardgrass	87.1 – 0.83(%ADF)
	17.	Rye	73.5 + 0.62(%CP) – 0.71(%ADF)
	18.	Ryegrass	87.1 – 0.83(%ADF)
	19.	Sorghum-Sudangrass	101.5 – 0.10(%EDP) – 1.02(%ADF)
	20	Sorghum-Grain type	109.1 – 1.69(%ADF)
	21.	Sorghum-Silage type	83.4 – 0.83(%ADF)
	22.	Soybean	73.5 + 0.62(%CP) – 0.71(%ADF)
	23	Straw of small grain	71.7 – 0.49(%ADF)
	24.	Triticale	73.5 + 0.62(%CP) – 0.71(%ADF)
	25.	Wheat	73.5 + 0.62(%CP) – 0.71(%ADF)
	26.	Matuagrass	87.1 – 0.83(%ADF)
Poultry Litters	30.	Breeder hen	
	31.	Broiler	
	32.	Pullet	
	33.	Turkey	
Others	35.	Cottonseed	
	36.	Soybeans	
	37.	None of the above	
Grains	40.	Corn	93.5 – 1.03(%ADF)
	41.	Mixed grains	93.5 – 1.03(%ADF)
	42.	Sorghum	93.5 – 1.03(%ADF)
	43.	Wheat, oats, rye	93.5 – 1.03(%ADF)

University of Arkansas, United States Department of Agriculture and County Governments cooperating

Appendix C.1. Understanding your hay analysis report part 1.

UofA UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE
Cooperative Extension Service

Understanding Your Hay Analysis Report

Here are a few tips to help explain the numbers on a forage analysis report to aid you in making harvest management; hay pricing or purchasing; and supplemental feeding decisions.

AS FED BASIS vs. DRY MATTER BASIS

- **As fed basis** refers to the sample's nutrient values before adjusting for water content. Since samples vary in water content, deducting the amount of the total sample weight contributed to water allows samples to be compared more accurately.
- **Dry matter basis** refers to the nutrient values after the water was deducted from the sample's weight.
- When comparing values between forages, compare them on a **dry matter basis**.
- When comparing values to an animal's requirement, compare them on a **dry matter basis**.

MOISTURE

- An accurate analysis of moisture is important for estimating total forage intake.
- Ideal moisture is < 15% for hay, 50 to 60% for haylage, and 60 to 70% for silage.
- Handle haylage and silage samples to avoid excessive evaporative losses between sampling date and submission to the laboratory.

CRUDE PROTEIN (CP)

- Crude protein is determined by measuring the nitrogen content of forage (N x 6.25 = CP).
- Excessive heat generated in bales with high moisture can cause protein to bind to fiber, reducing protein digestibility. If hay was baled wet, request an ADIN – adjusted crude protein. Deducting this nitrogen from the total plant nitrogen will yield a better estimate of available protein.

FIBER

- Neutral Detergent Fiber (NDF)
  - This represents the portion of the forage made up of cell wall (hemicelluloses, cellulose, and lignin).
  - This portion of the forage affects feed intake. As plants mature, NDF increases and forage intake is reduced.
- Acid Detergent Fiber (ADF)
  - This represents fiber (cellulose and lignin) that is poorly digested by the animal.
  - As plants mature, ADF increases and digestibility decreases.

NUTRIENT AND ENERGY VALUE

- Total Digestible Nutrients (TDN)
  - Total digestible nutrients is an **expression of energy**
  - For most classes of livestock, the **TDN (%)** listed at the bottom of the report is the most useful number in comparing forages.
  - This number estimates the protein, fat, and carbohydrate (sugar) in the forage that can be digested by the animal.
  - TDN is predicted from equations developed for different classes of forages: legumes, warm season grasses, and cool season grasses. As a result, it is very important to correctly identify the forage species type on the submission form.
  - TDN is commonly predicted from CP and ADF. Monitoring TDN can help determine if forages need to be harvested earlier to increase digestibility and energy supply.

Appendix C.2. Understanding your hay analysis report part 2.

NITRATE - NITROGEN

- Nitrates can be detrimental to animal health. Values below 700 ppm are considered safe, 700 to 1400 may be hazardous to pregnant or very young animals, 1400-2100 ppm may affect production and should be limited to less than half of the total ration, forages with values over 2100 ppm should not be fed.

RELATIVE FEED VALUE (RFV)

- Relative feed value can be calculated upon request. It is commonly used to compare forages and price forages based on their nutrient content.
- RFV is calculated from NDF and ADF. The table below shows RFV values for different levels of NDF and ADF. For example a sample that contains 35% ADF and 65% NDF will have an RFV of 88. This sample is of lesser quality than an RFV of 104.

TABLE OF RELATIVE FEED VALUES

	NDF (% DM)					
ADF (% DM)	**50**	**55**	**60**	**65**	**70**	**75**
25	129	117	108	99	92	86
30	122	111	102	94	87	81
35	115	104	96	88	82	76
40	107	98	90	83	77	72
45	100	91	83	77	72	67

REQUIREMENTS OF COMMON LIVESTOCK SPECIES

	CP (%DM)	TDN† (%DM)	(Ca %DM)	P (%DM)
Beef Cow				
Late Gestation	7.7	52	0.25	0.16
Early Lactation	9.9	58	0.28	0.19
Growing Calf				
1.5 lb/d gain	11.2	64	0.42	0.22
2.0 lb/d gain	12.8	69	0.52	0.25
Mare				
Late Gestation	10.6	57	0.38	0.24
Early Lactation	13.6	64	0.46	0.31
Growing horse				
Weanling	15.8	71	0.67	0.49
Yearling	12.6	64	0.41	0.31
Doe (female goat)				
Gestation	10.0	60	0.40	0.20
Lactation	12.5	63	0.50	0.25
Growing Goat				
Weanling	14.0	68	0.60	0.30
Yearling	12.0	65	0.40	0.20
Ewe				
Gestation	10.5	58	0.34	0.31
Lactation (twins)	14.8	65	0.39	0.29
Lactation (single)	13.3	65	0.37	0.28
Replacement ewe	9.1	58	0.32	0.16

†TDN (total digestible nutrients) is an expression of energy supply.

University of Arkansas, United States Department of Agriculture and County Governments Cooperating

Authors: Mr. Johnny Gunsaulis, Washington Co. Extension Agent and Dr. Shane Gadberry, Assistant Professor, Dept. Ansc, CES