Table 1: Suggested dietary nitrate thresholds for various state extension programs

State Extension Program	Author, Year	Safe to feed level	Caution feeding level	Toxic to feed level
		ppm NO_3-N DM equivalent		
Pennsylvania	Adams et al., 1992	< 1000	1000-1700	> 1700
Kansas	Roozeboom et al., 2011	< 1380	1380-2070	> 2070
Nebraska	Rasby et al., 2014	< 1500	1500-2100	> 2100
Oklahoma	Strickland et al., 2017	< 1150	1150-2300	> 2300
Colorado	Whittier, 2014	< 1150	1150-2300	> 2300
Iowa	Ensley and Barnhart, 2012	< 1500	1495-2300	> 2300
UC Davis	Maas, 2001	< 1500	1500-4000	> 4000
Florida	Halsey, 1998	< 1518	1518-4048	> 4048
North Dakota	Stoltenow and Lardy, 2015	< 1500	1500-4500	> 4500

*Calculations done using conversion factors in Adams et al. (1992)
*UC Davis reported in % NO_3-N
*OK, KS, CO reported in ppm NO_3
*FL reported in % NO_3
*KSU reported <690 safe and <1380 safe in most cases

Table 2: University of Nebraska-Lincoln grazing annual forage trials with retrospectively measured nitrate concentrations of the forage.

Trial	Forage Type	ppm NO_3-N DM	Animal	Year	ADG (lb./d)
1452	Oat, Turnip, Radish	6146	Steers	2014	2.2
1544	Oat, Turnip, Radish	4655	Steers	2015	1.3
1545	Oat, Turnip, Radish	2158	Heifers	2015	1.6
1546	Oats (Hill)	912	Steers	2015	1.1
1546	Oats(Valley)	4414	Steers	2015	1.5
1641	Oats (Hill)	3921	Steers	2016	2.3
1641	Oats (Valley)	8026	Steers	2016	2.5

Table 3: Differences in beef cattle producer responses regarding testing, use, and toxicity of annual forage pasture vs. hay.

	Grazing		Hay		
	n	%	n	%	*P*-value
Frequently test annual forage for nitrate[1]	114	n = 43 (38%)	115	n = 61 (53%)	0.02
Experienced an issue with nitrate toxicity when using annual forage[2]	110	n = 34 (31%)	24	n = 24 (21%)	0.09
Use forage that test high in nitrate[3]	108	n = 15 (14%)	40	n = 40 (36%)	< 0.01
Consulted vet for diagnosis is suspected nitrate toxicity[2]	97	n = 63 (65%)	46	n = 46 (50%)	0.04

[1] Responded frequently or very frequently

[2] Responded yes

[3] Responded almost always, usually, or often

Table 4: Effect of beef producers' previous experience with nitrate toxicity on their response regarding frequency of testing and use of annual forages that contain potentially toxic nitrate concentrations.

	Previously experienced toxicity		No previous issue		
	n	%	n	%	*P*-value
Test annual forage hay for nitrates[1]	24	n =13 (54%)	90	n =48 (53%)	0.94
Test annual forage pasture for nitrates[1]	34	n =16 (47%)	75	n =27 (36%)	0.28
Use annual forage hay that tested high[2]	24	n =11 (46%)	86	n =29 (34%)	0.28
Use annual forage pasture that tested high[2]	33	n =3 (9%)	72	n =12 (17%)	0.31

[1] Responded frequently or very frequently

[2] Responded almost always, usually or often

Table 5: Effect of species and moisture classification on nitrate concentration (mg NO_3-N/kg DM) of samples submitted by producers to a commercial laboratory for analysis.

	Brassica	Millet	Oat-pea mixture	Small Grain forages	Sorghum x sudangrass	Cover crop mixture	SEM[3]	*P*-value
Fresh[1]	4,060[a]	1,391[b]	-	1,008[b]	1,564[b]	1806[b]	419	< 0.01
	n = 63	n = 236		n = 70	n = 236	n = 34		
Dry[2]	-	617[bc]	789[ab]	469[c]	824[a]	-	120	< 0.01
		n = 327	n = 60	n = 595	n = 532			

[a-c] Values within row without the same superscript differ ($P \leq 0.05$).
[1]Fresh refers to samples with < 26% DM
[2]Dry refers to samples with > 84% DM
[3]Greatest SEM from species estimates reported

Table 6. Odds ratio (95% confidence interval[1]) of the likelihood that fresh samples in a species category contained greater than 2100 ppm NO_3-N DM relative to the likelihood of another species using multivariable logistic regression analysis

	Millet	Small grain forage	Sorghum x sudangrass	Cover crop mixture
Brassica	0.20 (0.09 to 0.46)	0.21 (0.11 to 0.42)	0.27 (0.16 to 0.47)	0.31 (0.15 to 0.65)
Millet		1.04 (0.44 to 2.42)	1.36 (0.65 to 2.83)	1.56 (0.64 to 3.76)
Small grain forage			1.31 (0.75 to 2.30)	1.50 (0.71 to 3.16)
Sorghum x sudangrass				1.15 (0.62 to 2.12)

[1]Confidence interval range that includes 1 indicates no difference in likelihood.

Table 7. Odds ratio (95% confidence interval[1]) of the likelihood that dry samples (>84% dry matter) in a species category contained greater than 2100 ppm NO_3-N DM relative to the likelihood of another species using multivariable logistic regression analysis

	Oat-pea mixture	Small grain forage	Sorghum x sudangrass
Millet	1.024 (0.474 to 2.213)	0.445 (0.288 to 0.689)	1.584 (1.096 to 2.290)
Oat-pea mixture		0.435 (0.201 to 0.941)	1.546 (0.741 to 3.229)
Small grain forage			3.556 (2.450 to 5.162)

[1]Confidence interval range that includes 1 indicates no difference in likelihood.

Figure 1: Location of survey respondents. (n = 115)

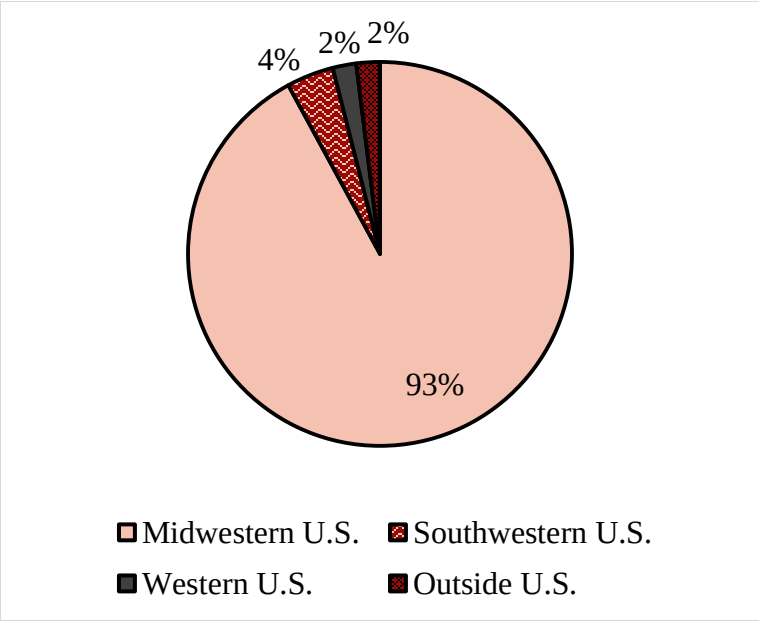

Figure 2: Survey respondent's indicated operation type (n = 115).

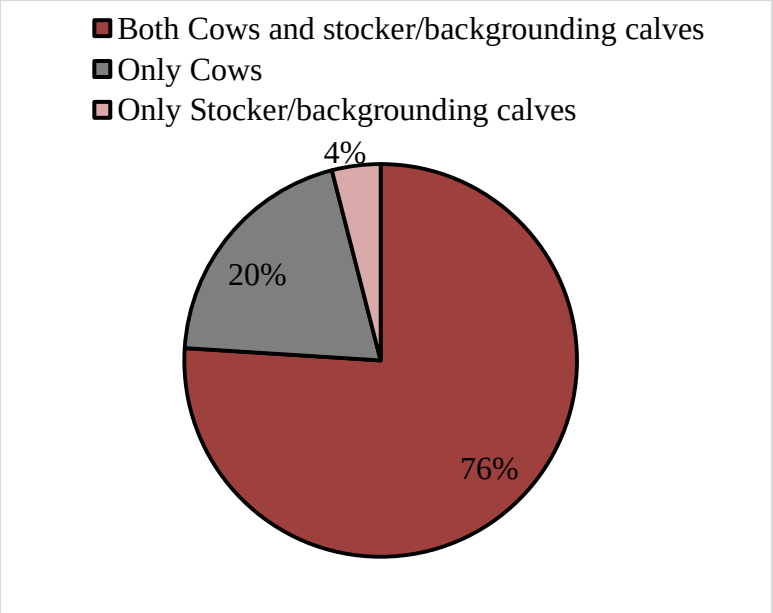

Figure 3: Survey respondents (n = 115) indicated operation size for either stocker/backgrounding operations (# of calves) or for cow/calf operations (# of cows).

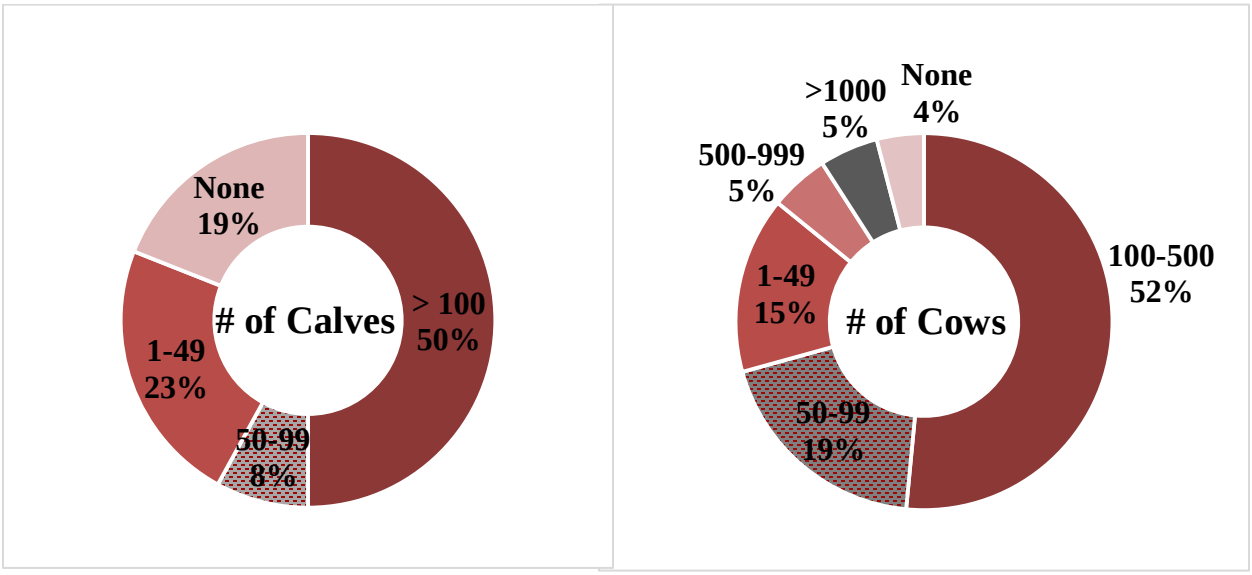

Figure 4: Proportion of producers (n = 109) that have experienced toxicity only when grazing annual forages (grazing), only when feeding annual forage hay (hay), both when grazing annual forages and feeding annual forage hay (both), or have not experienced issues when using annual forage pasture or hay (neither).

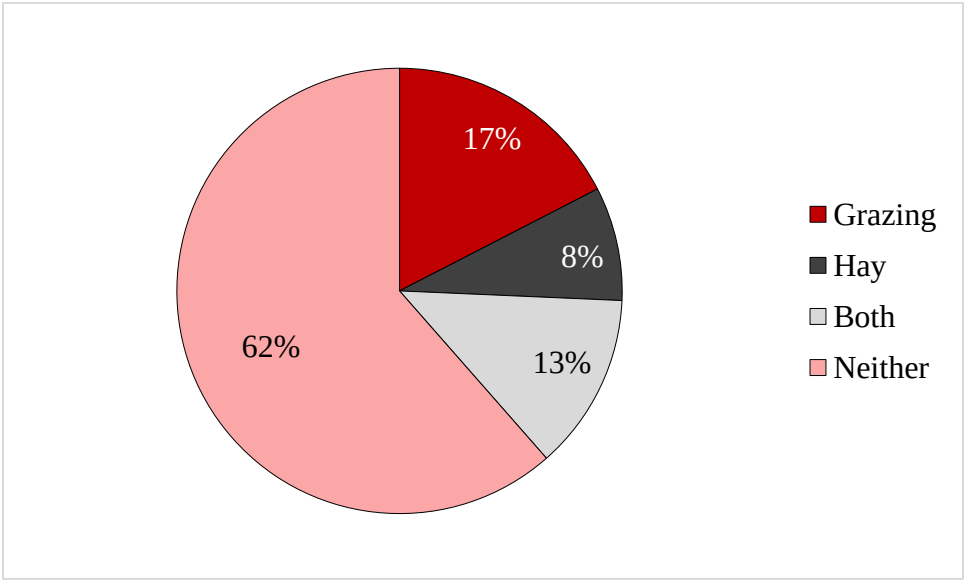

Figure 5. Distribution within risk of toxicity categories of fresh (< 26% dry matter; n= 443) annual forage samples submitted to a commercial laboratory for analysis of nitrate content (ppm NO_3-N DM).

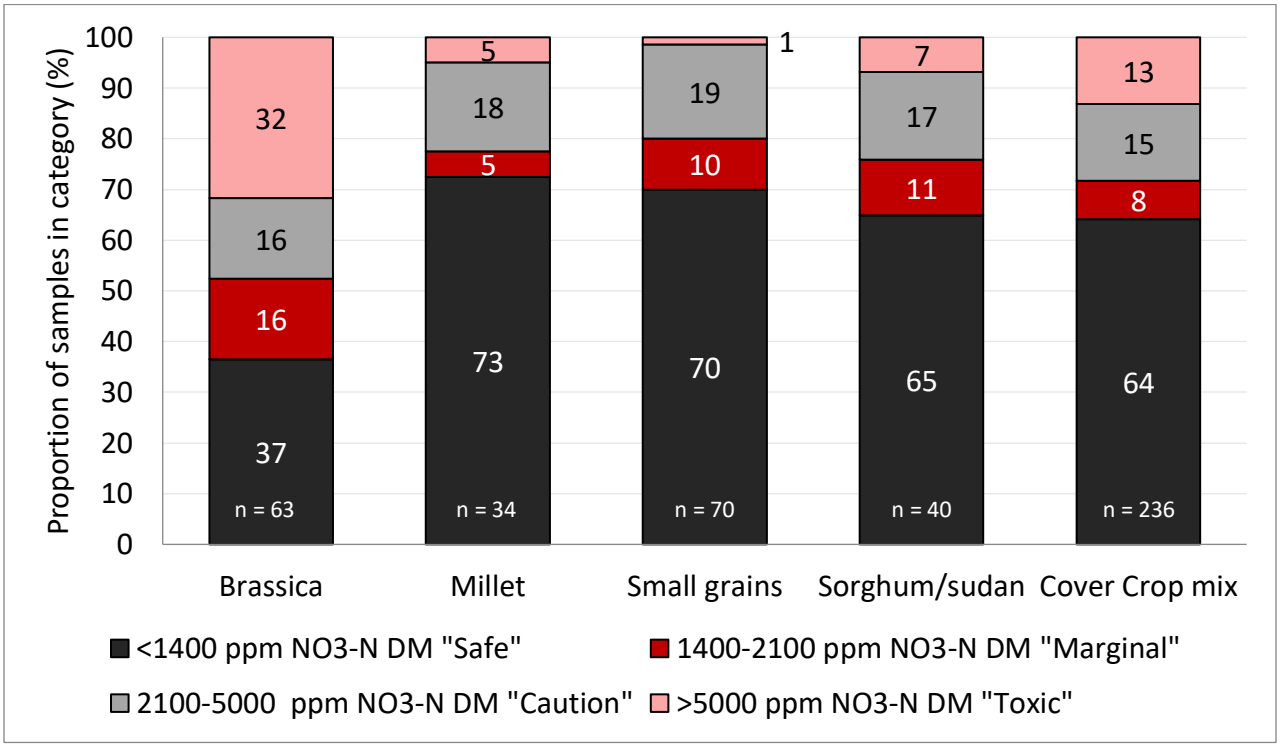

Figure 6: Distribution within risk of toxicity categories of dry (> 84% dry matter; n = 1514) annual forage samples submitted to a commercial laboratory for analysis of nitrate content (ppm NO_3-N DM).