MONTANA STATE UNIVERSITY EXTENSION

Alternative Forages: Quality and Management

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BOZEMAN, MT

Outline

- What species are available
  - Current research in MT
  - Forage Quality analysis
- Anti-quality factors to consider

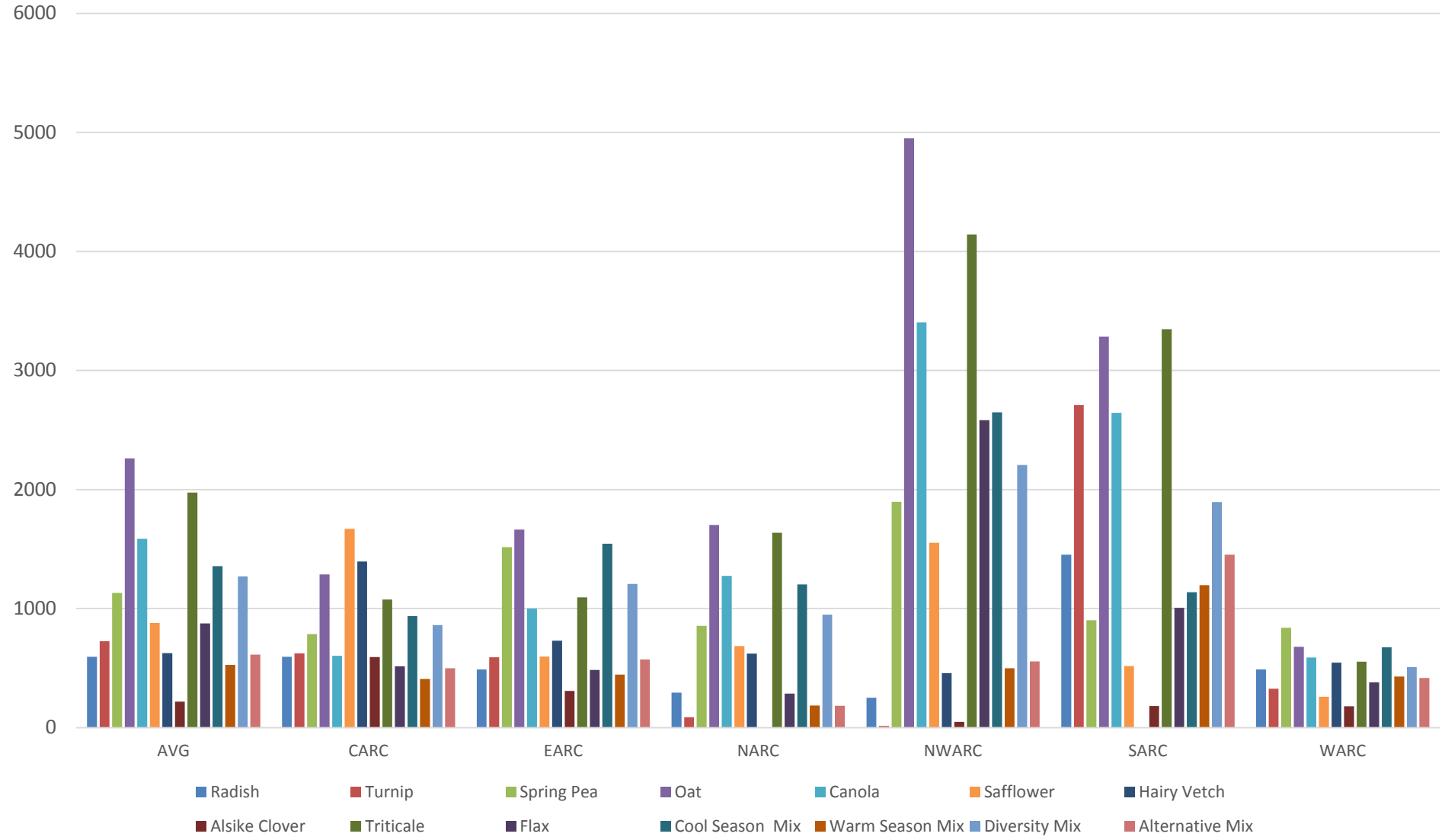
Species to consider

- **Wheat**
- **Barley**
- **Oats**
- Rye
- **Triticale**
- **Millet**
- **Sorghum**
- **Sudan**
- **Peas**
- ***Lentils***
- Beets
- ***Turnips***
- ***Clovers***
- ***Vetch***
- ***Safflower***
- ***Canola***
- ***Flax***
- Sunflower
- ***Radish***
- Mustard
- **Corn**

How to choose?

- Many options- pick which works best for individual situation
  - Cereals- high yielding, high quality, flexibility
  - Brassicas- retain quality late, good for late fall/ early winter forage
  - Warm seasons- good drought and heat tolerance, high yielding
  - Pulses- great quality, green manure source, water thrifty

Early Planted Herbage Mass Production
lbs/ acre

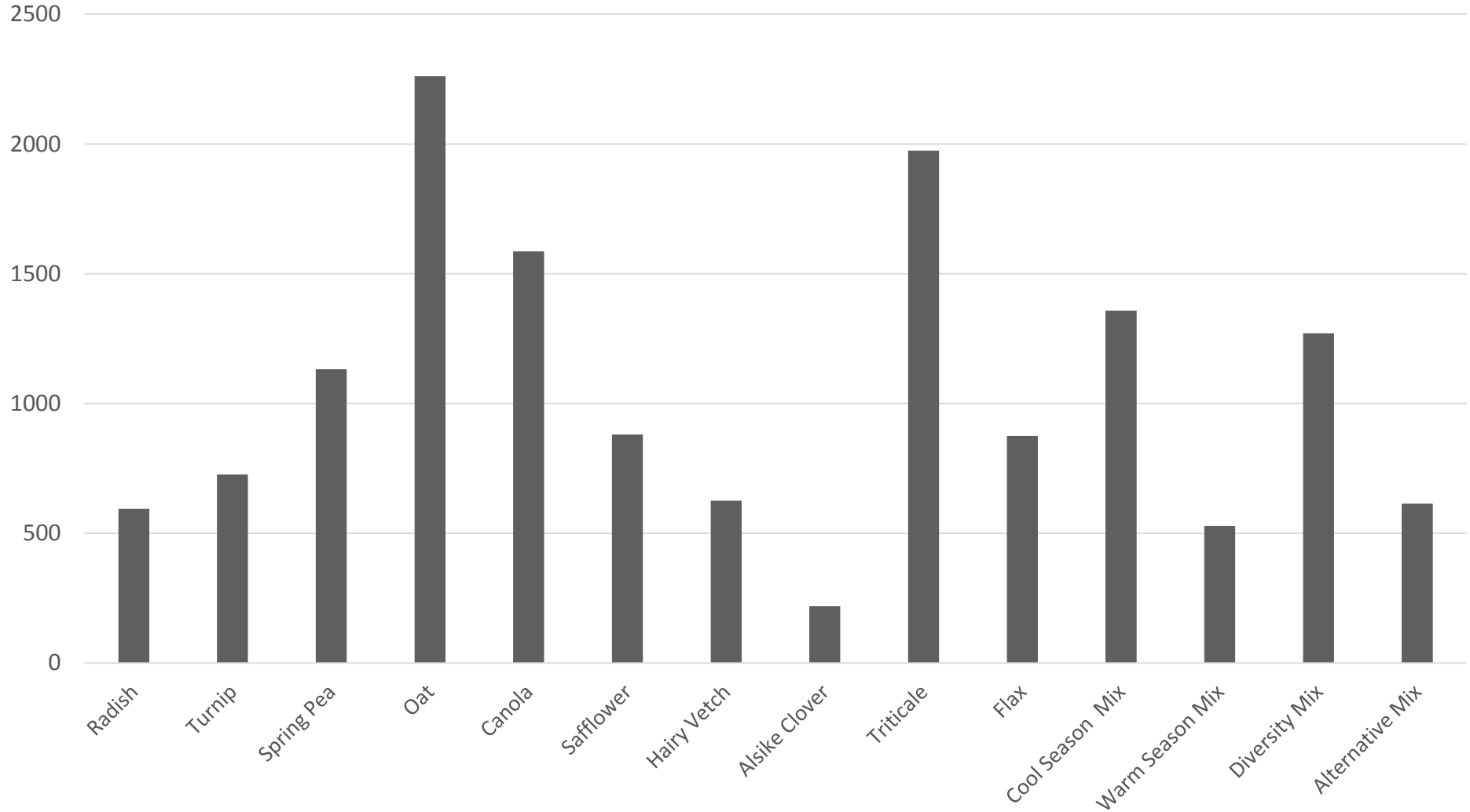


Source: Kent McVay. Evaluation of Multiple Species for use as Cover Crops in Dryland Production in Montana.

Cool Season Mix	Warm Season Mix	Alternative Mix	Diversity Mix
Radish	Radish	Radish	Radish
Turnip	Turnip	Turnip	Turnip
Spring pea	Chickpea	Faba Bean	Spring pea
Canola	Faba Bean	Black Bean	Faba Bean
Safflower	Sunflower	Teff	Chickpea
Oat	Sorghum	Indian corn	Canola
		Sorghum	Safflower
			Sunflower
			Oat
			Sorghum
$19.55	$39.95	$37.71	$29.27

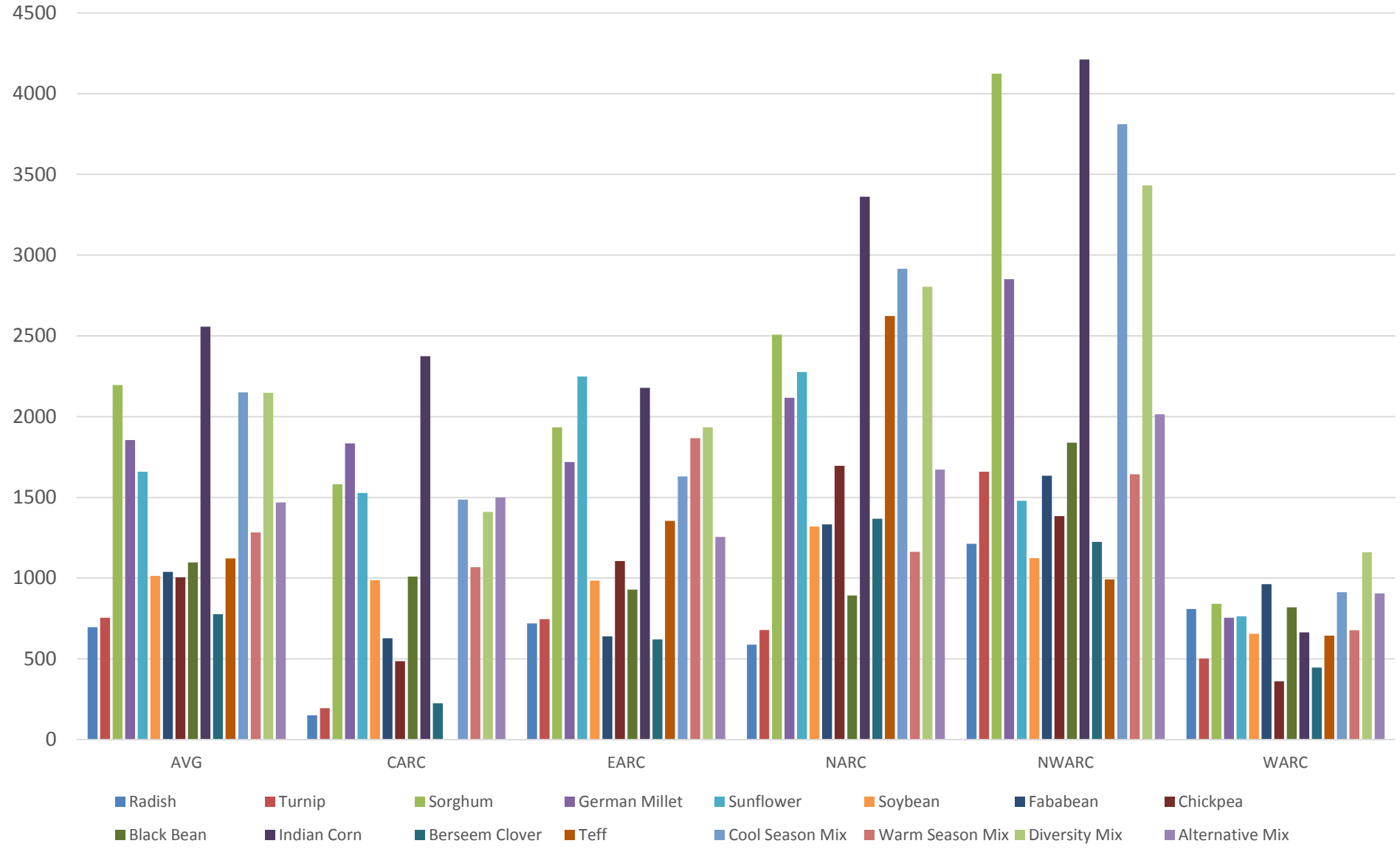
Source: Kent McVay. Evaluation of Multiple Species for use as Cover Crops in Dryland Production in Montana.

Early Planted Herbage Mass Production
State Average



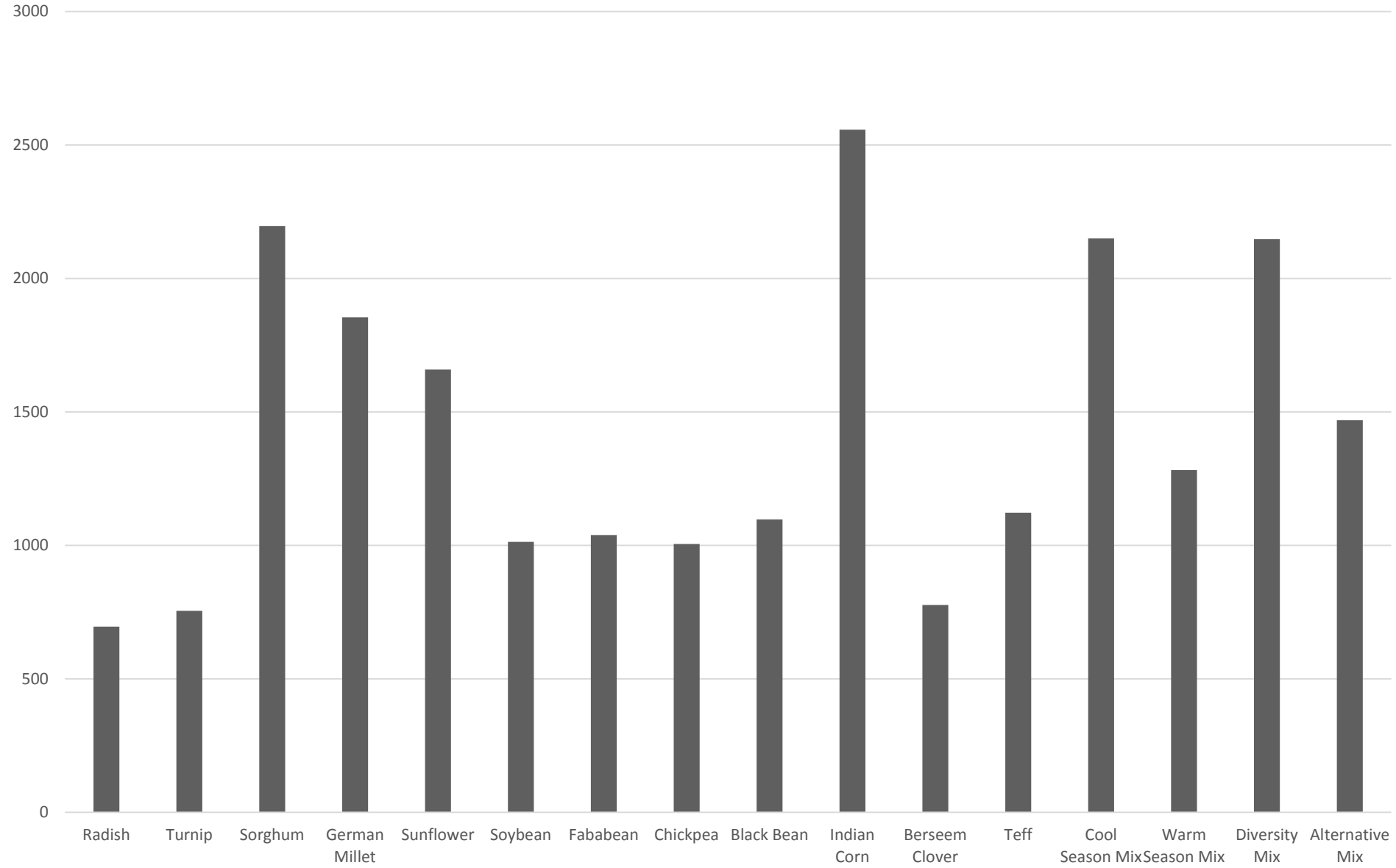
Source: Kent McVay. Evaluation of Multiple Species for use as Cover Crops in Dryland Production in Montana.

Late Planted Herbage Mass Production
Lbs/ acre



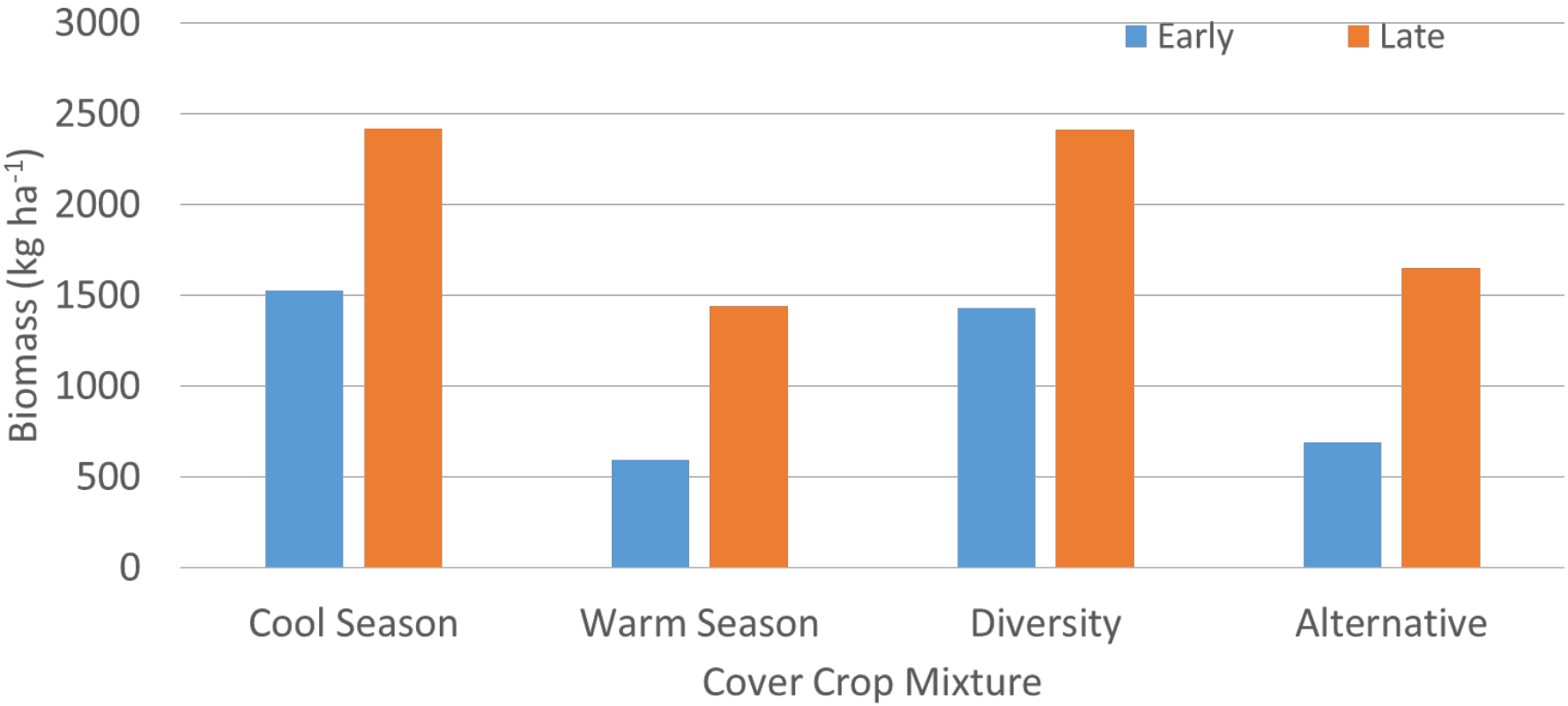
Source: Kent McVay. Evaluation of Multiple Species for use as Cover Crops in Dryland Production in Montana.

Late Planted Herbage Mass Production
Statewide Average



Source: Kent McVay. Evaluation of Multiple Species for use as Cover Crops in Dryland Production in Montana.

Impact of planting date on above ground biomass accumulation of mixed species plantings averaged across locations.



Source: Kent McVay. Evaluation of Multiple Species for use as Cover Crops in Dryland Production in Montana.

Established	Cover Crop	CP	ADF	NDF	TDN	RFV	NO_3
Early	Hairy Vetch	28	26	28	65	232	719
	Alsike Clover	21	25	31	63	215	195
	Pea	20	25	34	66	193	273
	Warm Season Mix	21	27	34	61	205	1294
	Turnip	19	30	33	57	208	3448
	Safflower	18	28	35	62	181	1086
	Alternative Mix	20	28	36	60	182	1991
	Radish	18	28	37	58	176	2100
	Diversity Mix	17	26	44	66	146	1110
	Cool Season Mix	16	28	45	65	141	955
	Canola	17	32	44	60	142	1778
	Oat	13	30	53	65	115	884
	Flax	14	35	51	61	115	162
	Spring Triticale	13	35	62	62	92	526
	average	18	29	40	62	167	1180
Late	Radish	16	24	30	65	161	165
	Purple Top Turnip	15	26	30	60	221	3350
	Sorghum	16	26	33	65	91	111
	German Millet	16	28	38	58	88	1634
	Sunflower	18	31	38	58	166	366
	Soybean	14	33	41	58	194	2223
	Fababean	14	33	44	59	159	86
	Chickpea	14	31	45	61	137	1957
	Black Bean	14	34	46	57	222	203
	Indian Corn	12	31	50	61	100	725
	Berseem Clover	13	31	51	62	129	985
	Teff	12	32	53	62	89	632
	Cool Season Mix	9	33	59	63	115	75
	Warm Season Mix	8	37	62	60	136	126
	Diversity Mix	10	35	64	61	119	263
	Alternative Mix	8	37	64	60	122	118
	average	13	31	47	61	141	814

- Each plot harvested at flower
- Mixes- when the grass species began to flower

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MREDI Trial-Costs

- Note- always calculate seeding rates on a pure live seed (PLS) basis

Purchase Price of MREDI Cover Crop Species			
Species	Bus. #1	Bus. #2	Seeds/lb
	$/lb	$/lb	
Bean, black[1]	8.00	NA	2,700
Bean, Faba	0.60	NA	2,500
Canola/rapeseed	1.00	1.04	175,000
Chickpea	0.60	NA	2,200
Clover, Alsike	2.25	NA	469,000
Clover, Berseem	2.50	NA	134,000
Clover, yellow sweet	2.05	2.51	174,200
Corn, grazing	0.45	4.30	2,500
Corn, Indian	3.00	NA	1,703
Flax	0.50	0.89	80,720
Lentil, Indian head	0.60		19,700
Lentil, Richlea	0.50	0.82	8,902
Millet, golden German	0.55	0.55	180,000
Millet, proso	0.30	0.65	120,000
Oat, spring	0.23	0.47	15,000
Pea, spring	2.05	2.67	3,200
Pea, Austrian winter	0.55		3,999
Radish	3.50	2.44	25,000
Safflower	0.65	1.22	15,000
Sorghum, grain	0.45	2.30	20,000
Sorghum x Sudangrass	1.20	0.93	18,000
Soybean, Non GMO	0.60	0.60	3,000
Sunflower, oilseed	0.50	1.12	8,000
Teff	2.25	3.69	1,000,000
Triticale, spring	0.30	0.44	15,000
Turnip, Purple Top	1.65	1.82	170,000
Vetch, hairy	2.05	2.67	12,000

Grazing Trial- Bozeman

Grazing Trial- Bozeman

Cultivar	Species	Initial Plot DM Herbage Mass[1] (kg)	Initial DM Herbage Mass (kg ha^{-1})	Residual DM Herbage Mass (kg)	Herbage Mass Removal (%)	Initial Plant Height (cm)	Residual Plant Height (cm)	Visual Removal Estimation (%)
Haybet	Barley	1857.9	11665.0	1096.9	50.6	70.4	41.7	31.7^{a}
Hays	Barley	1605.2	10078.4	758.9	50.5	51.1	40.1	50.0^{bc}
Haymaker	Barley	1765.9	11088.2	874.4	50.0	59.2	32.3	36.7^{acde}
Lavina	Barley	2013.9	12645.8	1016.6	48.7	65.3	41.4	33.3^{ade}
MT103083	Barley	1542.0	9681.7	848.8	45.8	53.6	31.5	48.3^{bcd}
Haxby	Barley	1934.1	12144.0	915.7	52.5	62.2	36.3	55.0^{b}
Horsford	Barley	1689.7	10609.1	806.8	51.2	56.4	42.4	48.3^{bcd}
Pronghorn	Barley	1817.4	11410.5	831.0	53.4	89.4	66.3	21.7^{e}
MT10397-1	Barley	1896.9	11910.9	1023.6	44.9	68.6	41.0	45.0^{abcd}
MT103038-6	Barley	1809.5	11362.0	818.6	54.3	45.0	25.7	56.7^{b}
MT103038-4	Barley	1878.5	11796.0	1070.7	42.2	52.3	33.0	48.3^{bcd}
MT103089-3	Barley	1806.6	12044.1	813.9	57.0	61.0	34.8	41.7a^{bcd}
MT103101-5	Barley	1461.1	9173.8	1000.0	38.3	64.3	40.6	46.7a^{bcd}
Otana	Oats	1822.3	11441.6	776.6	57.0	76.5	38.6	55.0^{b}
Stampede	Oats	1276.5	8014.1	586.6	53.6	43.4	14.5	86.7^{f}

Cultivar	Species	CP	ADF	CF	TDN	NEm	Nitrate
		%					% NO_3
Haybet	Barley	18.7	30.2^{a}	2.6	63.4^{acd}	0.64^{abd}	1.02^{ab}
Hays	Barley	21.4	26.7^{b}	3.5	63.3^{a}	0.64^{a}	1.19^{a}
Haymaker	Barley	20.1	28.0^{ab}	2.5	62.9^{a}	0.64^{ab}	0.98^{ab}
Lavina	Barley	18.7	29.3^{ab}	3.4	64.1^{abc}	0.65^{abde}	0.82^{b}
MT103083	Barley	21.5	29.3^{ab}	2.9	60.5^{cd}	0.61^{cb}	1.11^{ab}
Haxby	Barley	17.8	26.9^{ab}	4.3	64.3^{a}	0.66^{d}	0.89^{b}
Horsford	Barley	16.2	30.4^{a}	2.8	62.1^{abcd}	0.63^{abcde}	0.77^{b}
Pronghorn	Barley	18.5	33.4^{ac}	3.9	63.0^{ac}	0.64^{ab}	0.46^{b}
MT10397-1	Barley	20.0	29.6^{ab}	2.9	62.7^{acd}	0.64^{abcd}	1.19^{ab}
MT103038-6	Barley	20.8	25.9^{b}	2.7	62.8^{ac}	0.64^{abd}	1.23^{ab}
MT103038-4	Barley	19.1	26.5^{ab}	3.2	62.6^{abc}	0.63^{abd}	1.09^{ab}
MT103089-3	Barley	18.6	31.3^{a}	3.1	61.4^{acd}	0.62^{abc}	0.97^{b}
MT103101-5	Barley	17.3	27.8^{abc}	3.0	65.0^{b}	0.66^{e}	0.76^{b}
Otana	Oats	18.5	35.0^{c}	2.7	62.3^{c}	0.63^{b}	2.53^{c}
Stampede	Oats	20.3	27.0^{ab}	3.7	60.3^{d}	0.60^{c}	2.10^{c}

- No correlation between preference and any nutrient level

How do pulses stack up?

Table 3. Hay yield and quality at Amsterdam, MT, 2003 and 2005.

	Hay yield		Relative Feed Value		Crude protein	
	-------- Mg ha^{-1} ------				-------- g kg^{-1} ------	
	2003	2005	2003	2005	2003	2005
	P-values					
Crop	*0.13*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*
Harvest	*< 0.01*	*< 0.01*	*0.10*	*0.27*	*< 0.01*	*< 0.01*
C x H	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*
	Mean values for the 'Flower' and 'Pod' Hay Harvest Timings					
Flower	2.68	4.28	175	143	168	182
Pod	4.40	6.85	168	138	120	136
	Crop means at the 'flower' and 'pod' harvest timings for pea hay harvest					
Flower						
Barley	2.45 b	6.21 a	122 b	97 d	119 c	86 d
Barley/pea	2.91 a	4.22 b	129 b	117 c	111 c	143 c
Spring pea	3.03 a	4.18 b	219 a	165 b	189 b	228 b
Winter pea	2.33 b	2.49 c	230 a	194 a	256 a	271 a
Pod						
Barley	3.99 bc	8.45 a	155 b	114 b	96 c	79 c
Barley/pea	3.84 c	6.91 b	149 b	125 b	83 c	114 b
Spring pea	4.24 b	5.31 c	184 a	150 a	130 b	173 a
Winter pea	5.54 a	6.73 b	183 a	165 a	169 a	177 a

Miller et al. 2016. Pea harvest timing impacts forage yield and quality, subsequent wheat. Submitted. Journ. Agron.

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C x H	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*
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	DM Yield	Hay Yield (15% Moist.)	Silage Yield (40% DM)	Protein	TDN	RFV
	Tons/ acre			%		
Field Peas	1.95	2.29	4.88	16.95	67.67	145.57
Barley	1.78	2.09	4.45	9.74	64.08	126.76
Field Peas/ Barley	2.18	2.56	5.45	13.65	65.12	132.75
Oats	1.78	2.1	4.45	9.44	60.58	116.09
Field Peas/ Oats	2.17	2.55	5.42	12.48	62.94	118.75

Anderson and Ilse. “Field peas make excellent quality forage for beef cattle”. 2011. NDSU Extension.

What about warm-season grasses?

Warm season grass trial: Bozeman, MT Season Average

Variety	Type	Yield	CP	TDN	ADF	NO_3
		(pounds/ acre)		%		% NO_3
12SB0001	PPS	3120	20.2	65.6	32.4	1.86
12SU9002	PPS	4310	19.7	64.0	33.8	1.45
12SU7006	BMR	3427	18.9	60.8	36.6	1.60
14SU7003	Control	4157	18.7	67.7	30.6	1.44

Individual Harvests

Variety	Type	Yield		CP*		TDN		ADF		NO3	
		(pounds/ acre)		%						% NO3	
		Harvest 1[a]	Harvest 2[b]	Harvest 1[a]	Harvest 2[b]	Harvest 1	Harvest 2	Harvest 1	Harvest 2	Harvest 1[a]	Harvest 2[b]
12SB0001	PPS	3120	5241	20.1	19.5	64.0	67.2	33.8	31.0	2.34	1.38
12SU9002	PPS	4310	6858	20.4	18.9	59.8	68.2	37.5	30.1	1.63	1.27
12SU7006	BMR	3427	7161	19.8	17.9	61.6	60.1	35.9	37.3	2.19	1.02
14SU7003	CON	4157	6115	19.6	17.8	67.2	68.1	31.0	30.2	2.00	0.91

- Denotes a significant impact of rep (Rep 1> Rep 2> Rep 3), indicating impacts of field placement on results
- [a,b] in title column denotes a signficant impact of harvest on results

Forage Quality Analysis- Recommendations

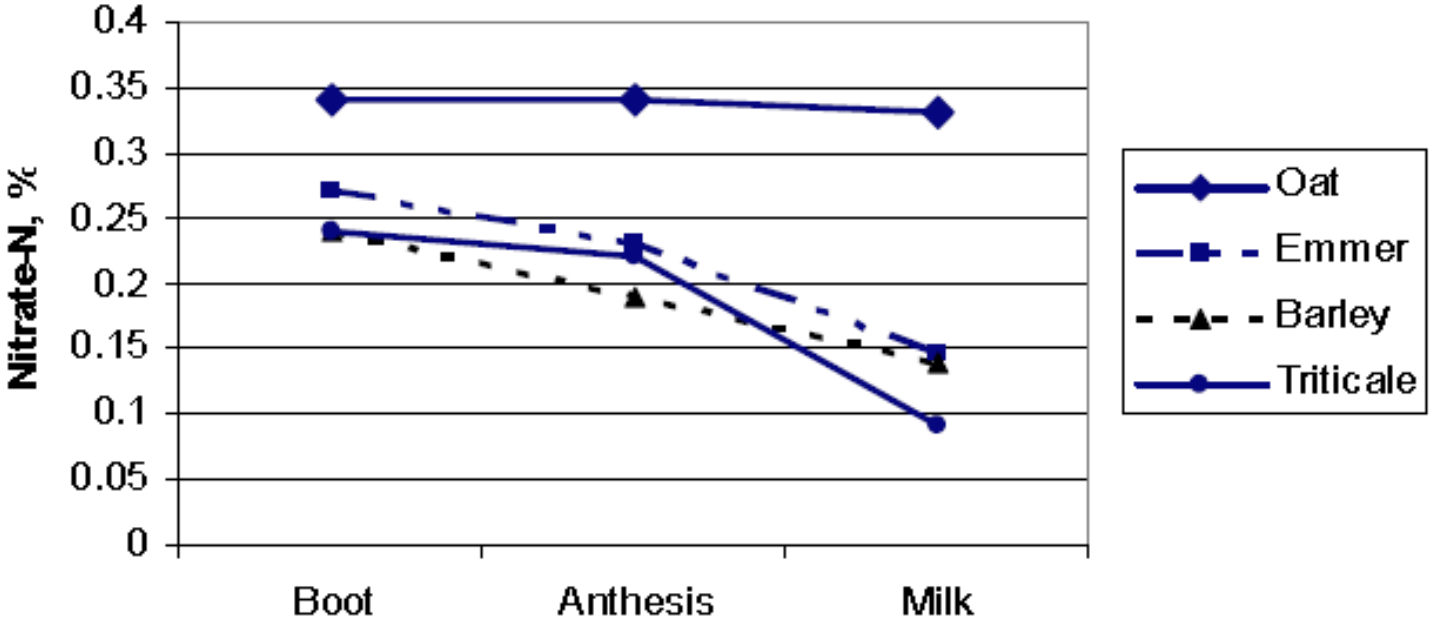
- Always test
- So much variability
  - Within species
  - Location
  - Harvest date
- Base feeding recommendations off analysis
- Look at energy (TDN), protein, and nitrates
  - Minerals?

Forage Quality Analysis

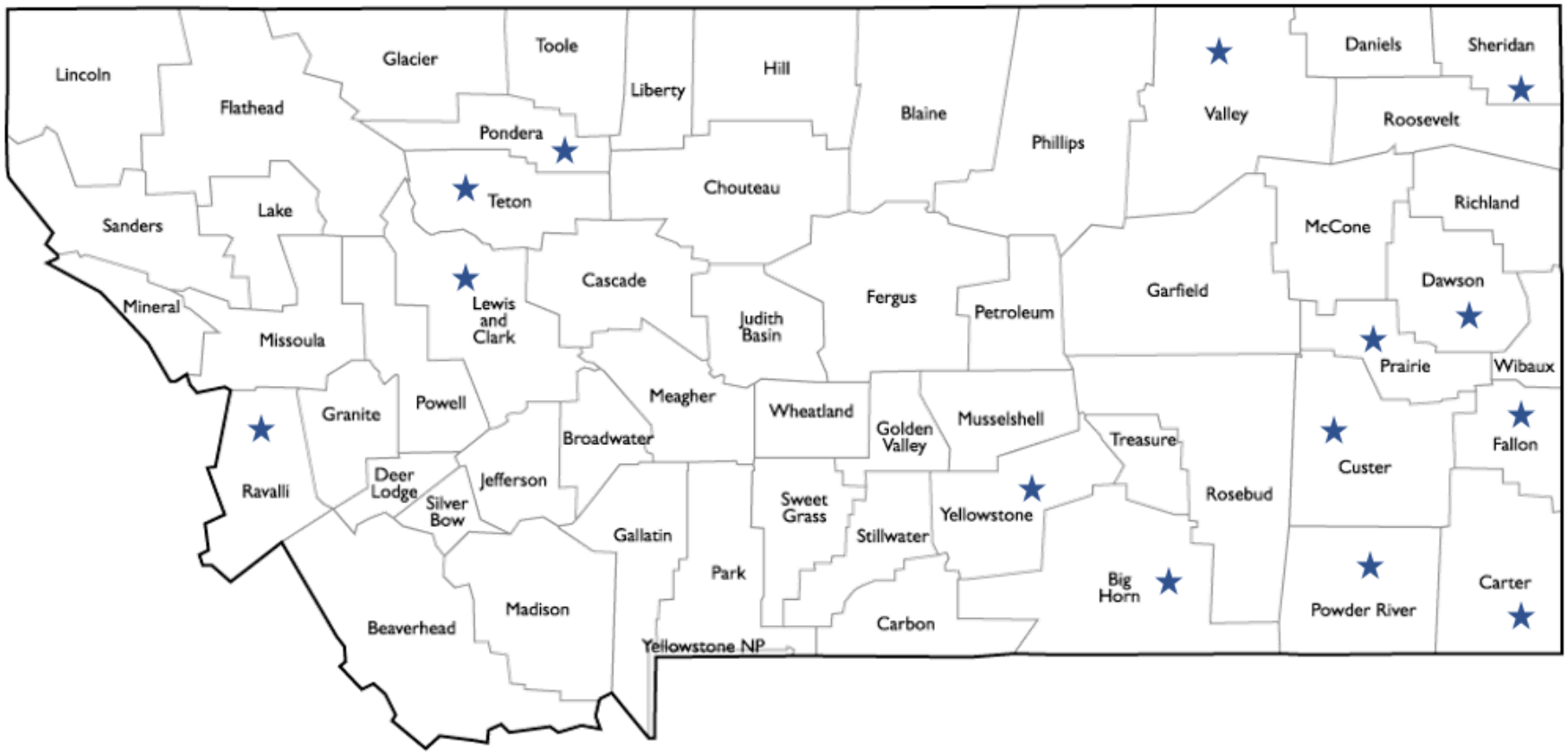
- Harvest timing should be based off needs
- Earlier harvest -> increased quality but decreased yield
  - Cereals- early heading or soft dough?
  - Peas- depends on goals
    - Water use increases past first bloom, but so does yield
  - Warm season- ??
    - Decreased risk for nitrates and prussic acid
  - Brassicas- leaf loss at later maturity
    - Plant after June 15 to prevent bolting

Anti-Quality Factors

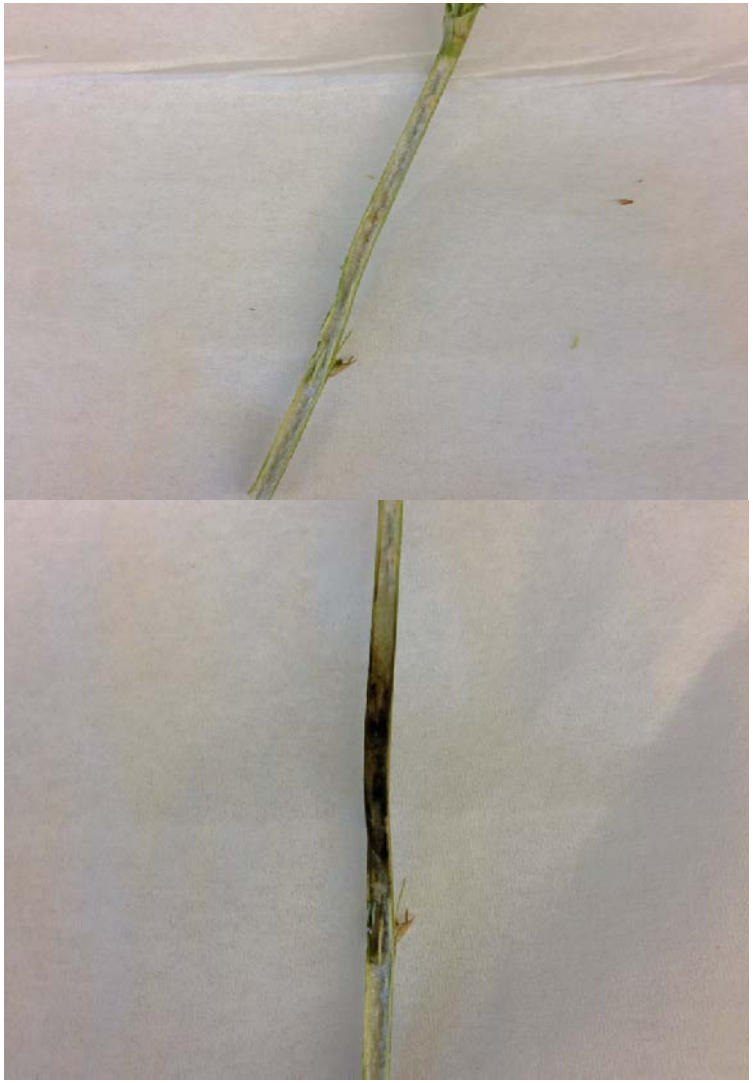
- Nitrates “widest-spread” concern
- Does the QuikTest work?
  - Are there any other tests available for producers?



Nitrate Research-
Test Evaluation



Nitrate QuikTest



Pros

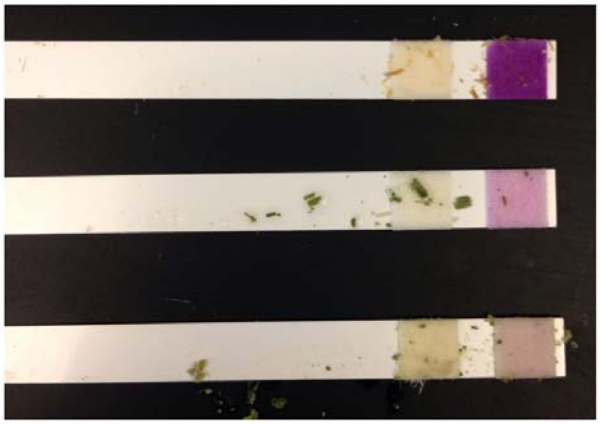
- Quick
- Easy
- Cheap
- Can do in-field
- Same day results

Cons

- Only certified personnel allowed
- Acid is extremely caustic
- Is it reliable?

Nitrate Strip Tests

Nitrate Strip Test Levels				
Nitrate (ppm)	<1500	1500-5000	5000-10,000	>10,000
Strip Test Color				



Strip Tests used to sample forages with different levels of nitrates.

Top: Barley (>10,000 ppm nitrate)
Middle: Corn (1500-5000 ppm nitrate)
Bottom: Alfalfa (1500-5000 ppm nitrate)

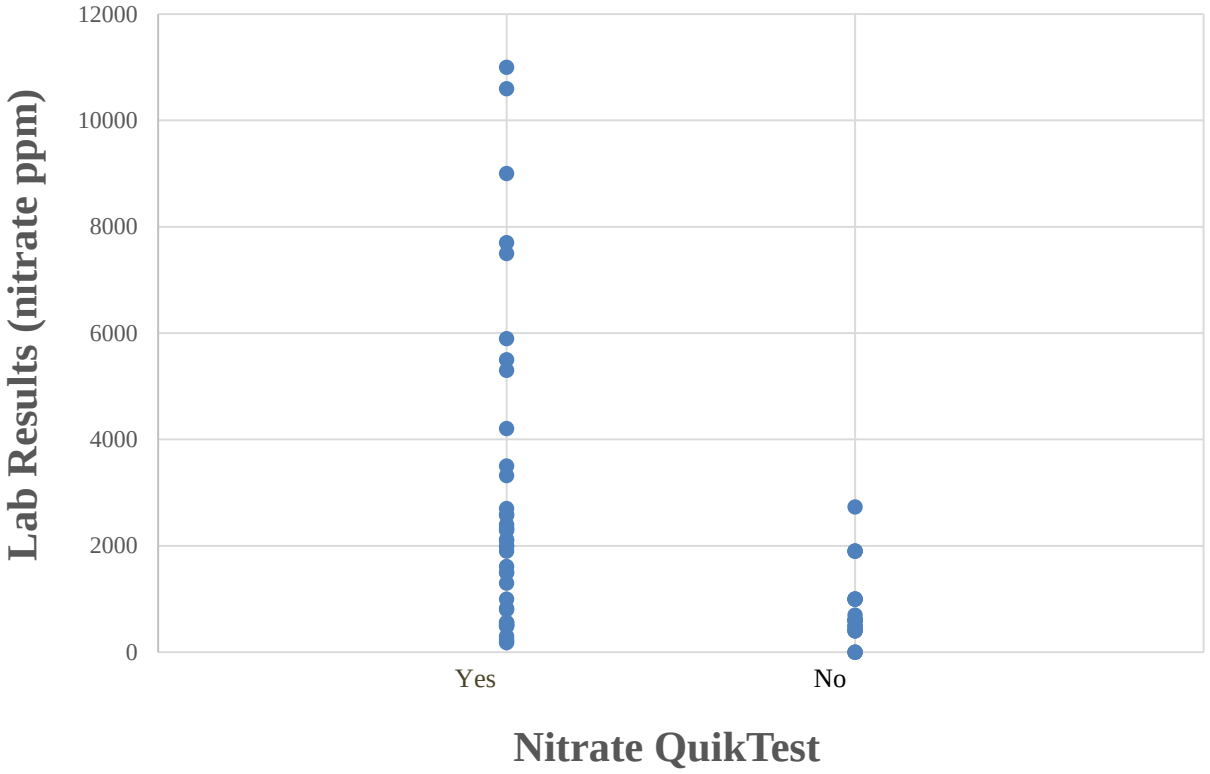
Pros

- Quick
- Easy
- Commercially available
  - No certification required
- More “defined” results

Cons

- Higher cost to producer
- Takes a little longer than QuikTest
- Reliability?

Nitrate QuikTest Compared to Lab Results



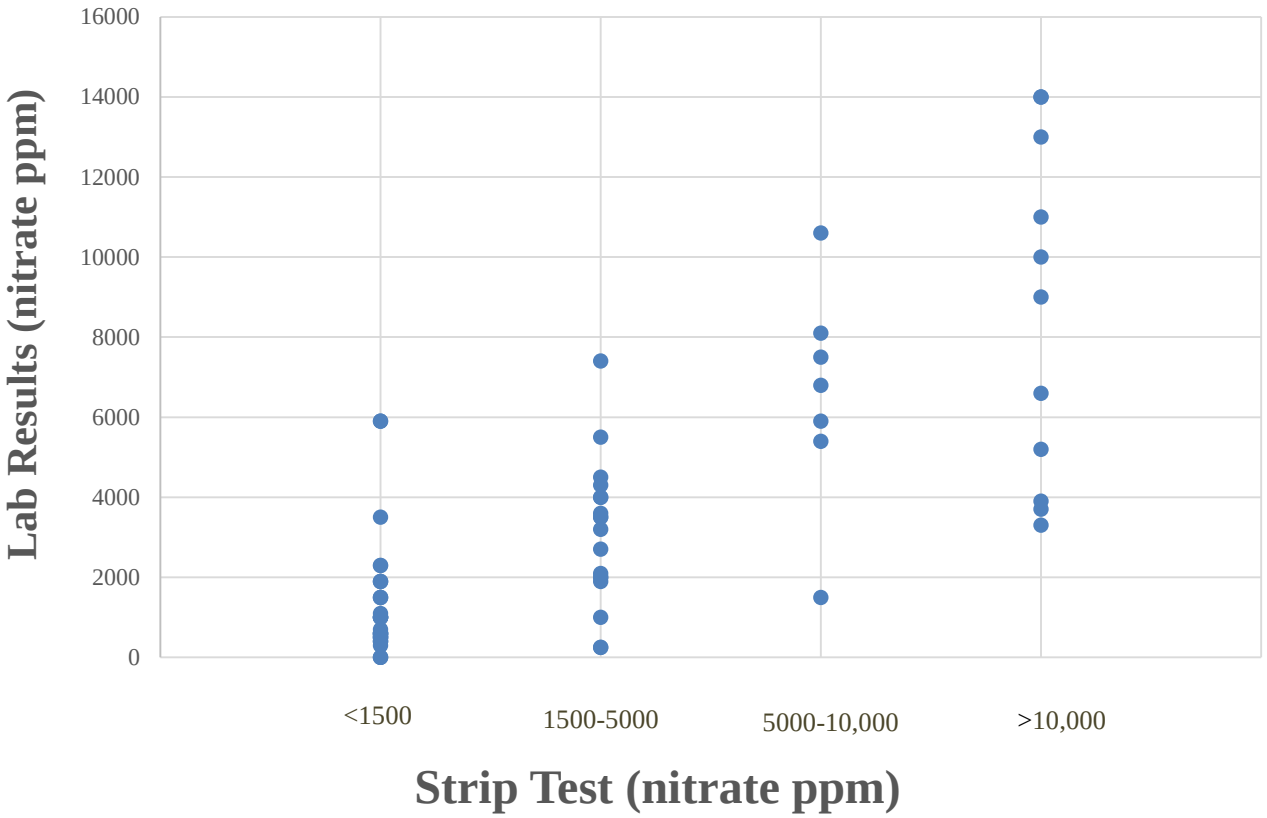
Yes = nitrates present No = nitrates absent

P = 0.0019

-Accurately estimated levels compared to lab analysis 69% of the time (44/64 samples)

-Of the 31% that were incorrect, 87% of those were false negative (31% overall)

Nitrate Strip Test Compared to Lab Results



P = < 0.0001

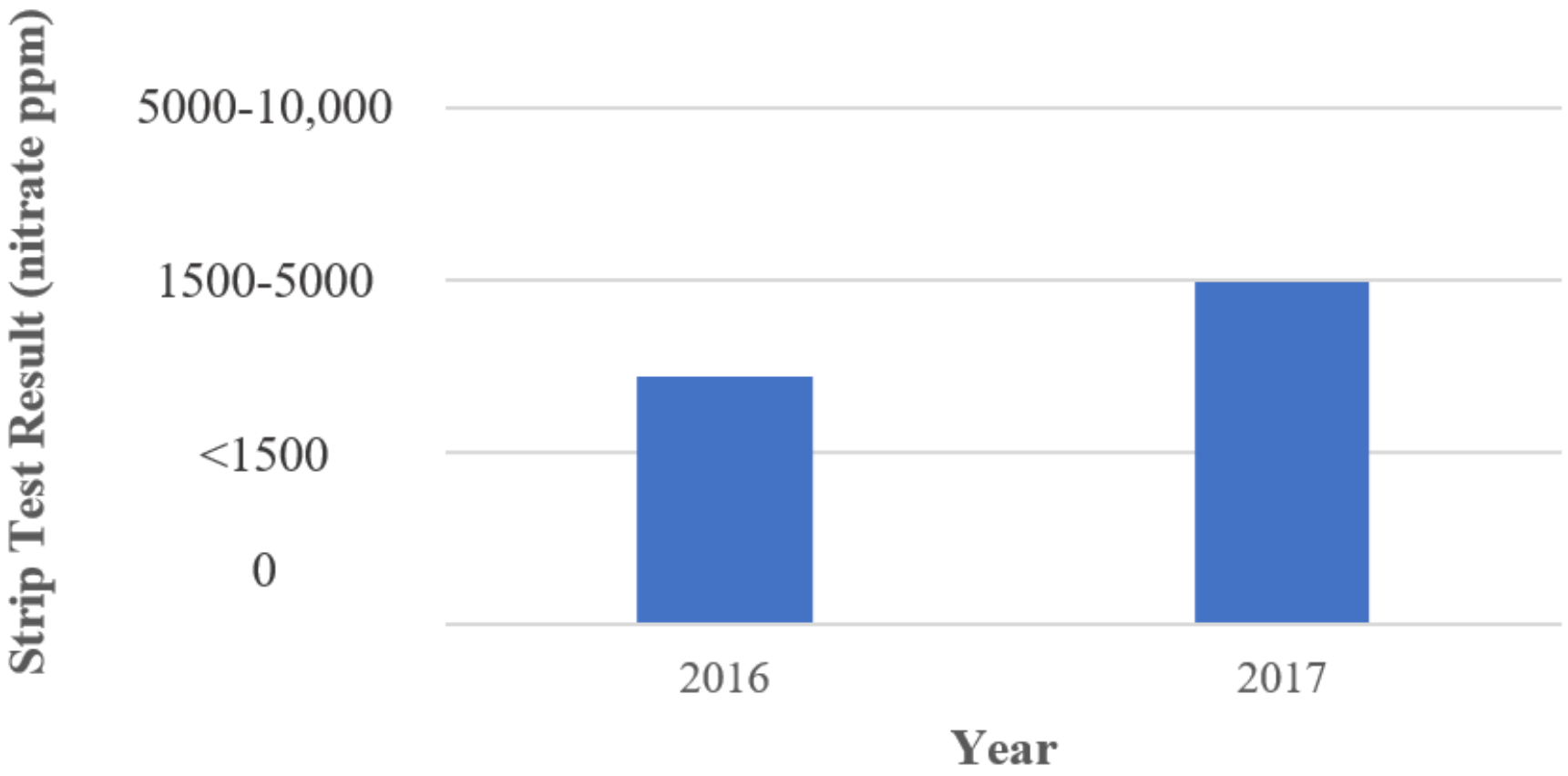
Strip Test Categories
1: < 1500 ppm
2: 1500-5000 ppm
3: 5000-10,000 ppm
4: < 10,000 ppm

-Correctly estimated results compared to lab analysis 73% of the time (true positive; 53/73 samples)

-45% of the incorrect tests (12% overall) were false positive (overestimated; 9/20)

-Remaining 55% (15% overall) were false negative (underestimated; 11/20)

Nitrate Strip Test Results Seperated by Year



Others to think about

- Prussic acid
  - Test strips available
  - Otherwise, hard to test for
  - WSG (sorghum highest)
- Photosensitivity
  - Buckwheat
  - Some clovers
- Sweet clover toxicity
  - Only in hay, not grazed


Questions?
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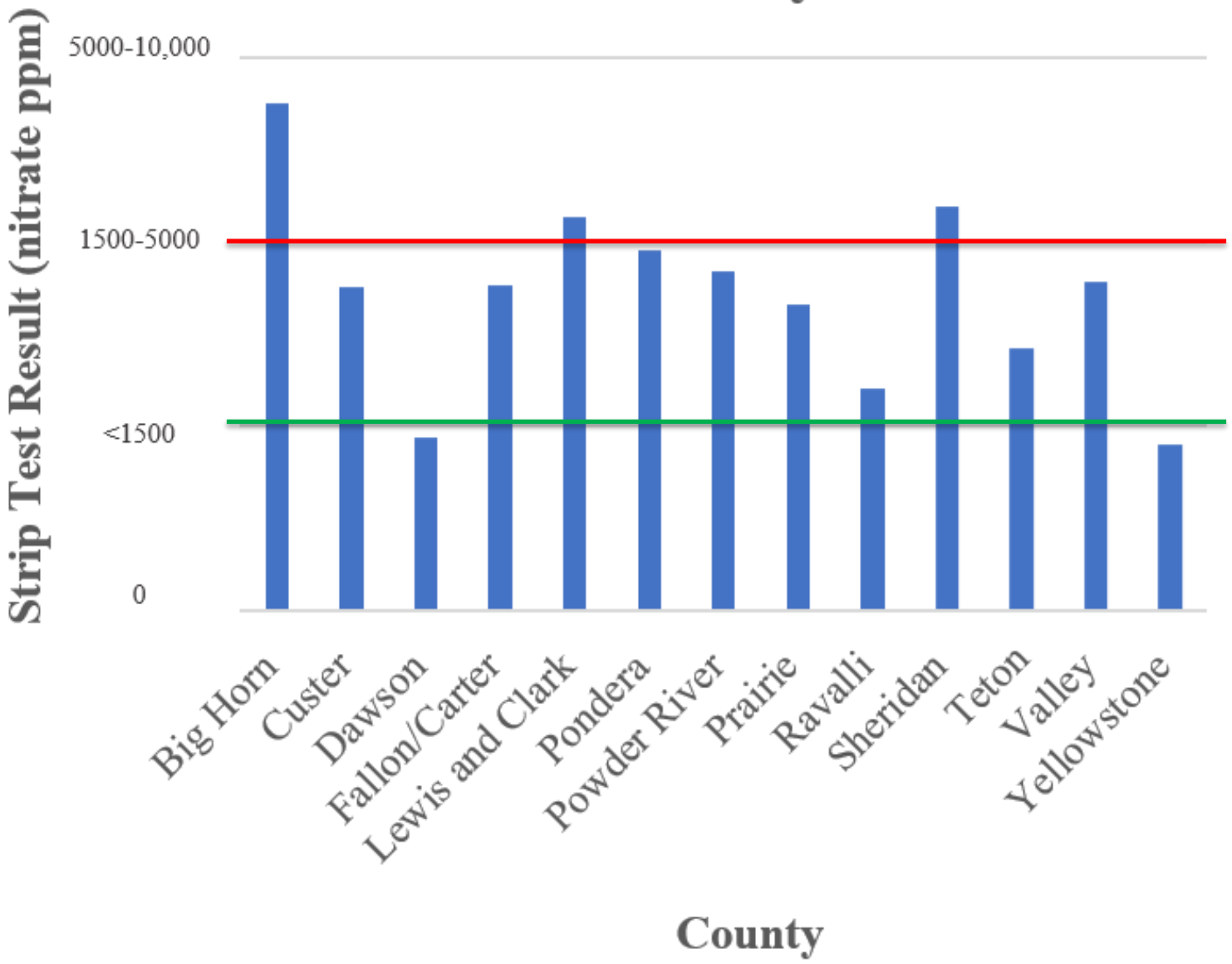
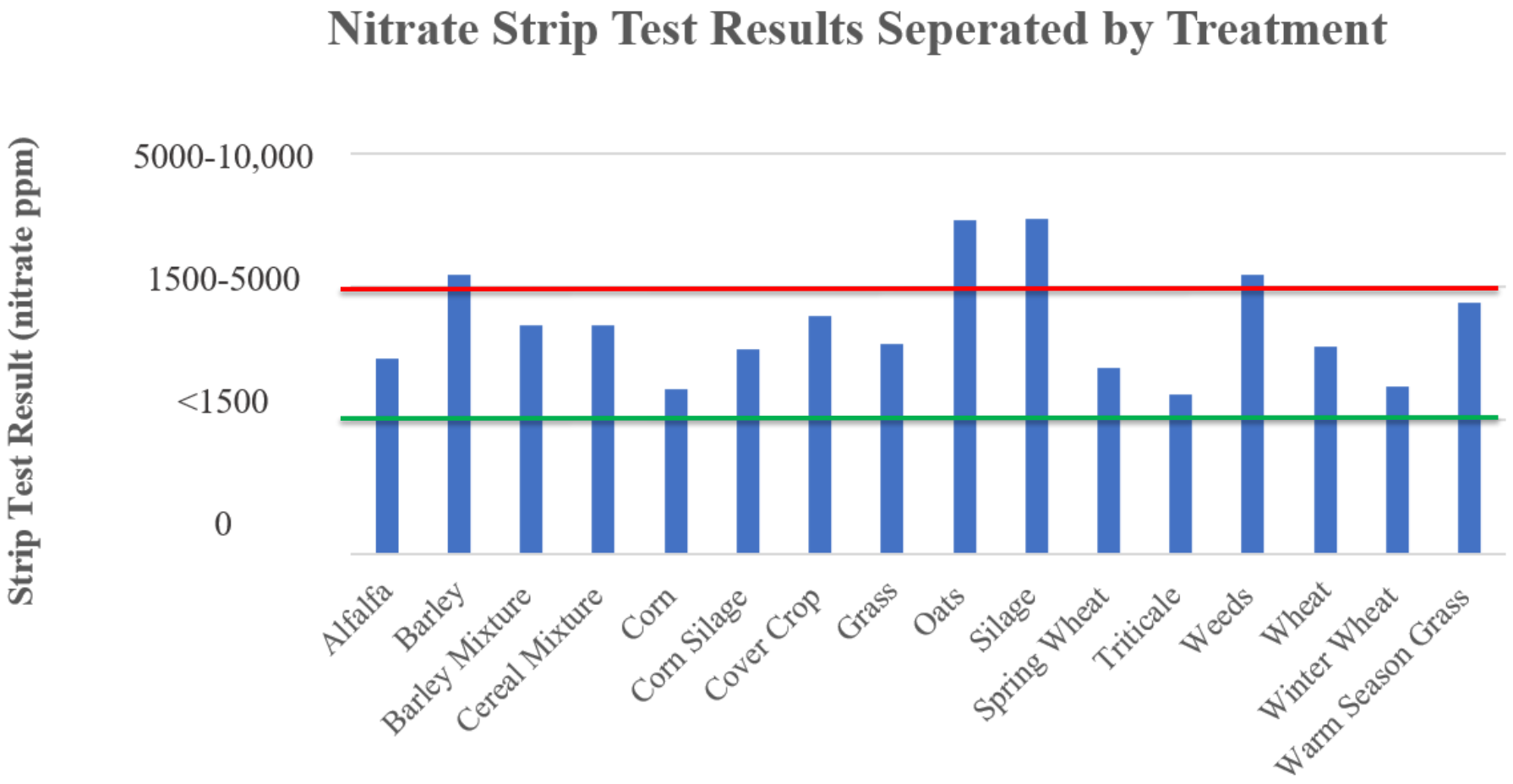
Nitrate Strip Test Results Seperated by County




Nitrate Strip Test Results Seperated by Treatment
Strip Test Result (nitrate ppm)
5000-10,000
1500-5000
<1500
0
Alfalfa
Barley
Barley Mixture
Cereal Mixture
Corn
Corn Silage
Cover Crop
Grass
Oats
Silage
Spring Wheat
Triticale
Weeds
Wheat
Winter Wheat
Warm Season Grass