Evaluation of Grazing Systems in the southern Great Plains of USA

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Background:

B.S. Texas Tech, M.S, OSU, PhD Texas A&M,

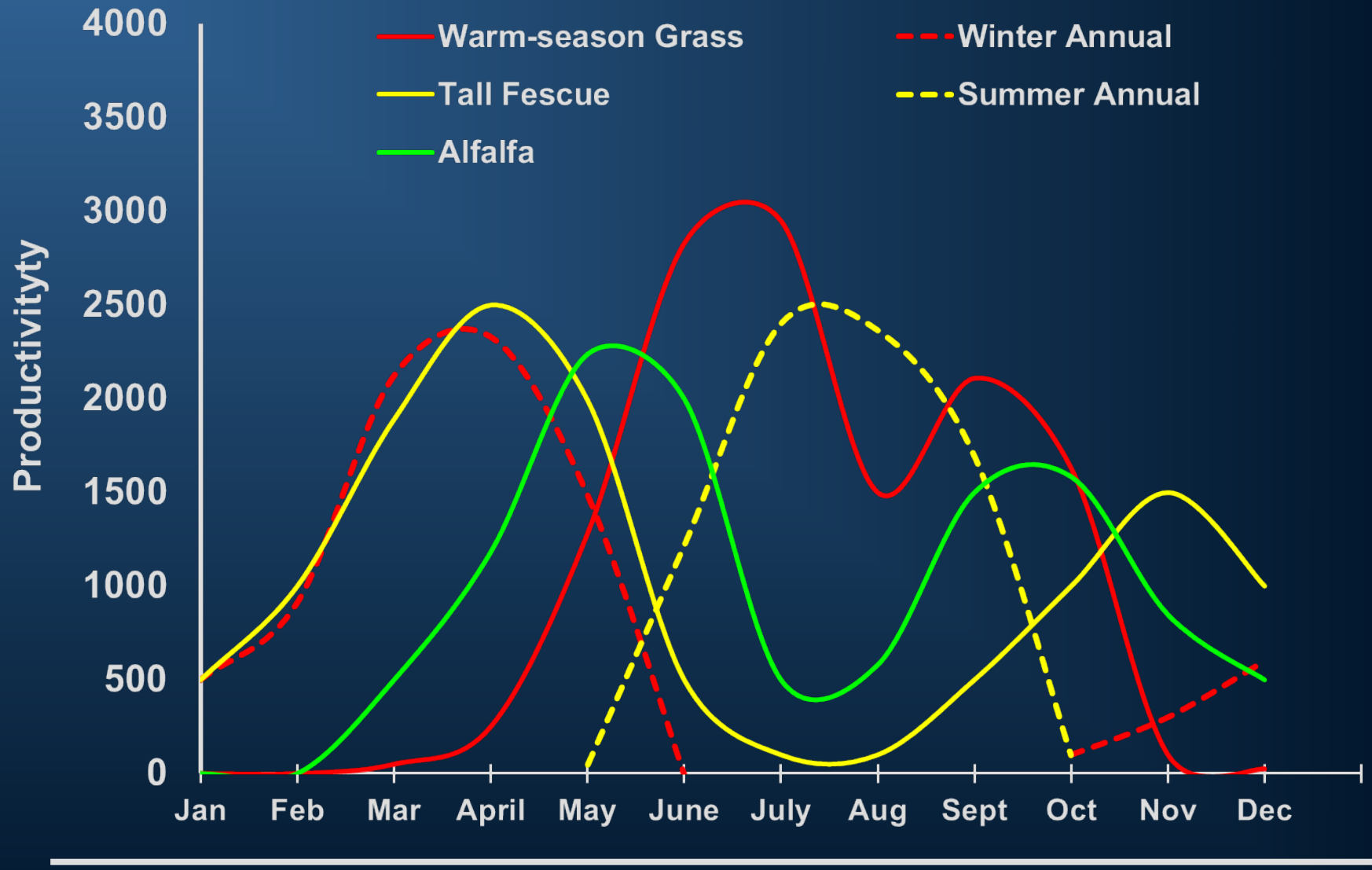
Professor Forage Agronomy; Noble since 2004

Research Emphasis: Grazing systems, Agronomy, Sensor evaluation, and Cover Crops

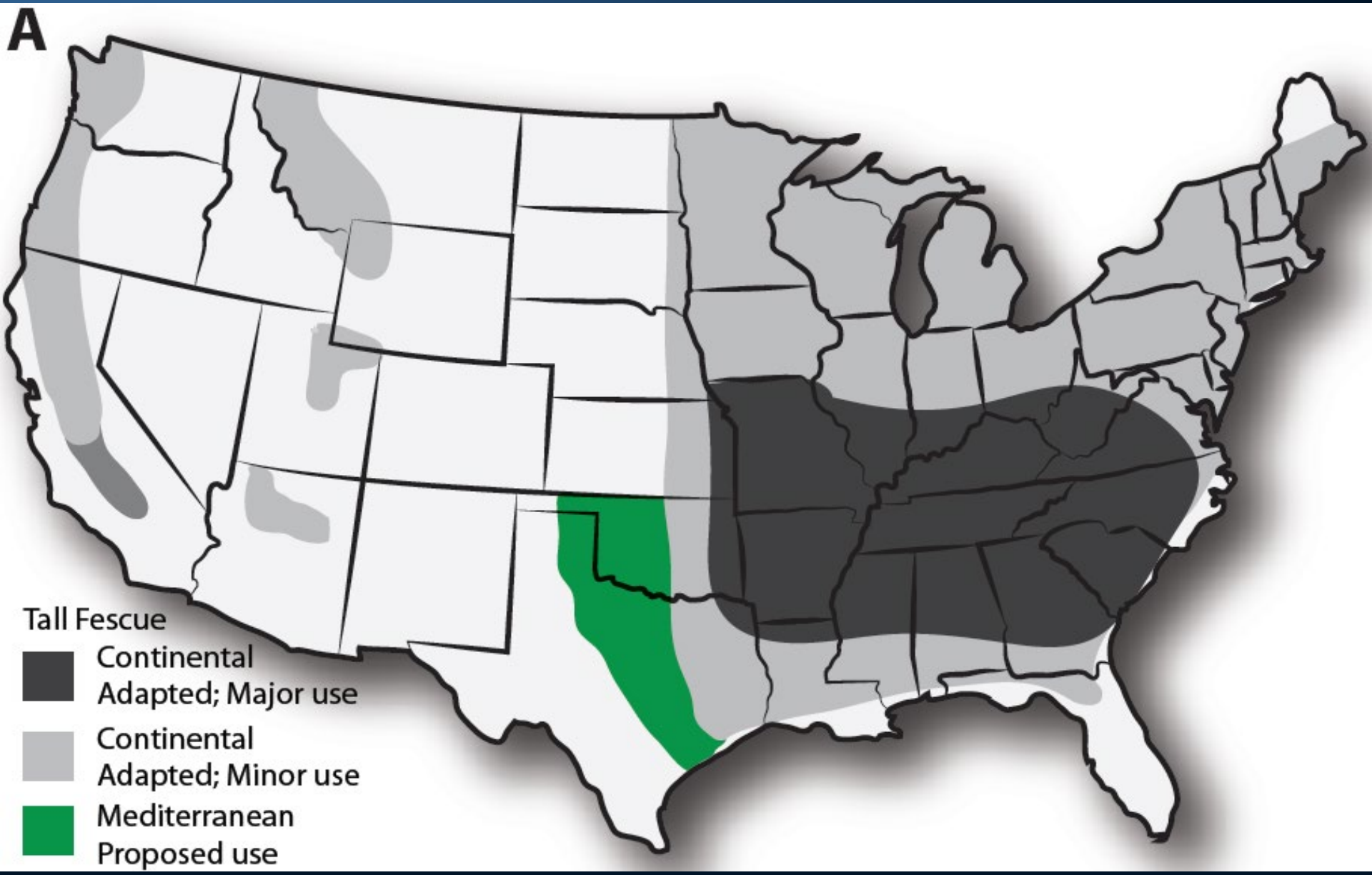
Outline

- Introduction (year-round grazing)
- Establishment
- Grazing Systems Research
  - Cool-season (small grains, tall fescue, alfalfa)
  - Warm-season (Bermudagrass/Alfalfa)
  - Monoculture alfalfa
- New technology
- Summary and Conclusions

Ideal Forage System



Tall Fescue Utilization in the USA



SDTF Establishment - Monoculture

Herbicide Screening

- PRE, early-POE
- 20 herbicides

No herbicide would selectively control annual ryegrass without killing SDTF

Agronomic Method

Planting date (Sept – Oct) x glyphosate timing (spring – autumn)

Cool-season perennial grass establishment

No glyphosate, Sept planting

May glyphosate, Sept planting

Oct glyphosate, Oct planting

May + Oct glyphosate, Oct planting

Alfalfa-Tall Fescue Establishment - M&M

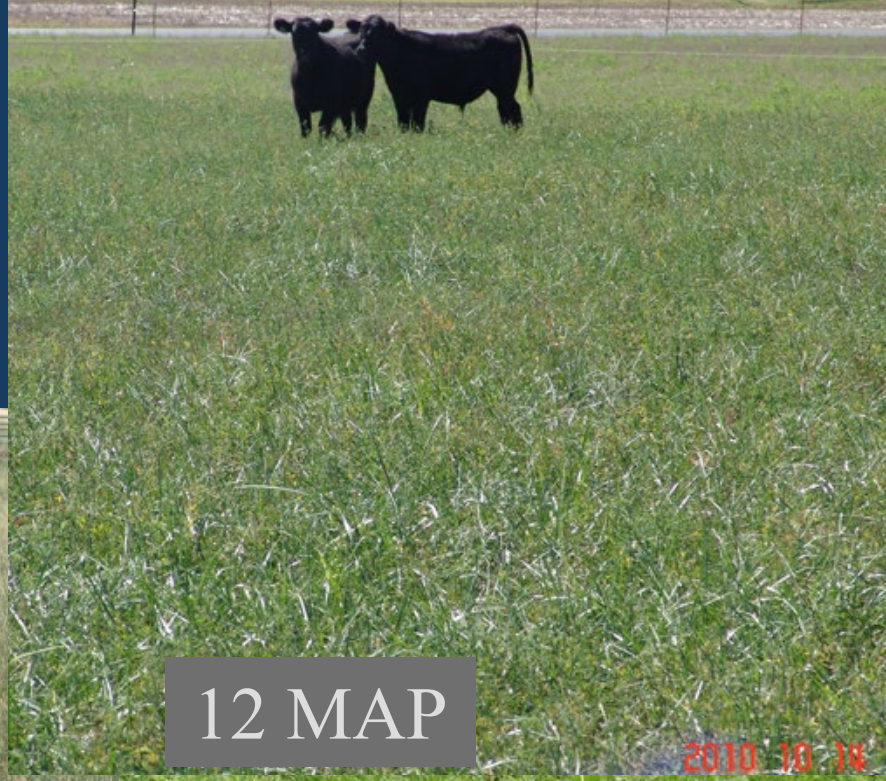
- Clean-tilled seedbed
  - Roller-packed (firm)
- Planted in Sept each year
  - 2008 and 2009
  - 25, 30, 35 inch rainfall zones
- No-till drill with 2 seedboxes
  - TF in grain box
    - 15 PLS
  - Alfalfa in legume box
    - 12 PLS

Tall Fescue-Alfalfa Establishment

Alfalfa-TF alternating rows – 2 YAP

Establishment Summary

24 MAP



12 MAP

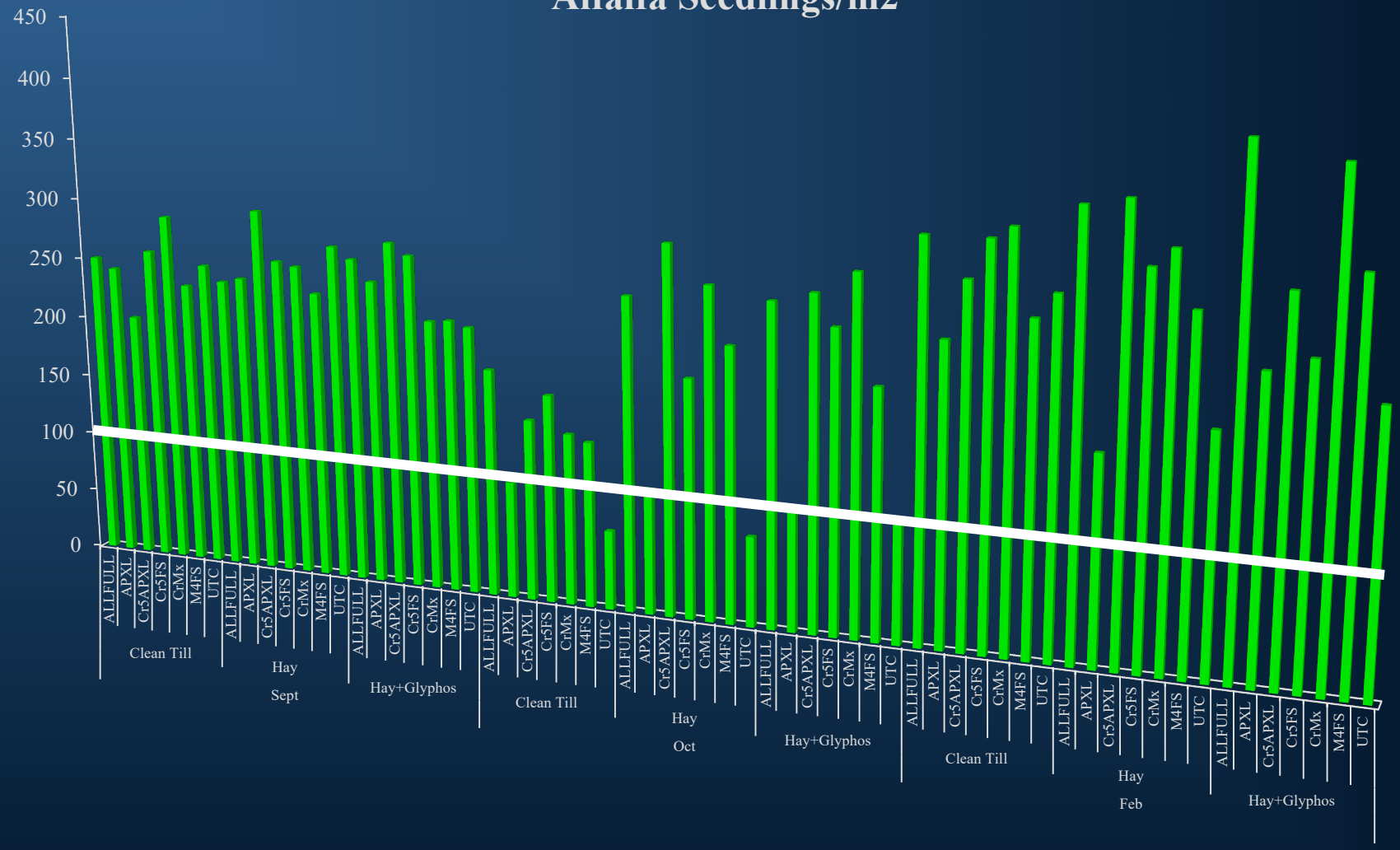
Checker board orientation

6 MAP

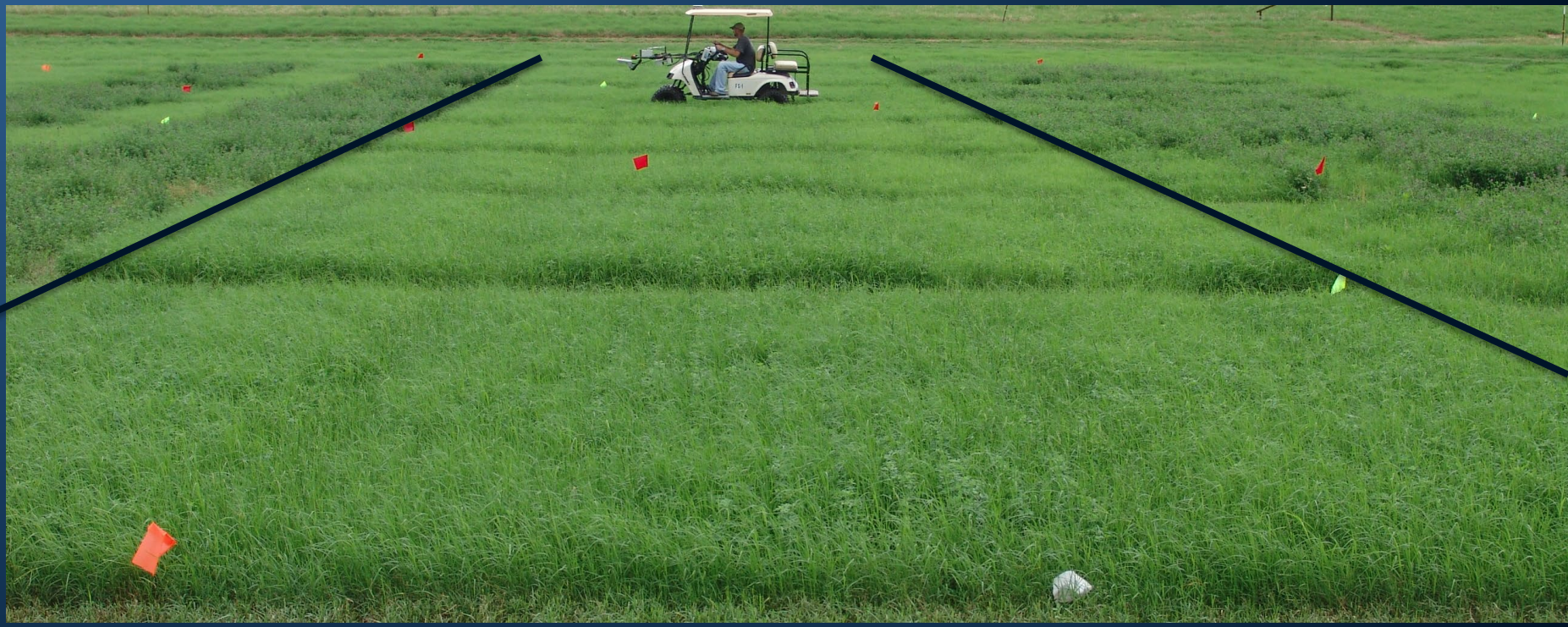
Alfalfa-Bermudagrass Establishment – M&M

- RCBD with 4 reps each in 2012-13 and 2013-14
  - Main plot: Planting date (**Sept 15**, Oct 15, Feb 15)
    - 12 lb PLS/A
  - Sub-plot: Seedbed preparation
    - Hay (H), H**ay-Glyphosate (HG), Tillage (CT)**
  - Sub-sub-plot: Seed treatment
    - Fungicide, **Insecticide**, **Combination** seed treatment
    - Sub-sub-sub-plot: Post-emergent insecticide (no effect)

Alfalfa Seedling Counts – 30 DAE



Planting Date: Sept vs Feb vs Oct



Sept Planting Date:
Hay/Glyphosate vs Hay vs Tillage

Establishment Summary

C3PG: spring/fall glyphosate to control grassy weeds

Alfalfa-TF: “checkerboard” orientation

Alf-BG: **Sept Glyphosate / No-till drill is Easiest and Cheapest**

- Early Frost negated Oct Glyphosate (1 yr)
  - Optimal Seed treatment – any with Cruiser insecticide
  - No benefit to post-emergent application of insecticide

Grazing Systems Research

- Forage mass
- Nutritive value
- Forage allowance
- Average daily gain
- Total gain
- Total grazing days

- Economics: Net Returns

Economics

Expected Net return = (gross revenue – input costs)

Expected Revenue = total gain (TG) x value of gain (VOG)

TG = total no. grazing days/unit area x ADG

$VOG=(Wt_2 * price_2 – Wt_1*price_1)/Wt_2– Wt_1$

Input cost = establishment cost (amortized) plus maintenance cost (fertilizer, chemical, mowing, interest, etc.)

Results: Cool-season Systems

2013-18	Stocking rate	Actual days	Average daily gain	Grazing days acre^{-1}	Gain acre^{-1}
5-yr avg.	AU acre^{-1}	# days	lb day^{-1}	days acre^{-1}	lb acre^{-1}
Wheat-100 N	1.0	118	2.16	165	356
Crabgrass	2.0	46	1.68	134	226
Alfalfa (only)*	1.1	90	2.04	110	224
W-A-C 2 paddock system		**254**	**2.02**	**210**	**424**
Tall fescue-N fertilizer	1.0	144	1.81	188	340
Tall fescue-Alfalfa*	1.7	103	2.23	154	343
TF-wheat-TF system (20 bu wheat)		187	1.98	157	311

Alfalfa was replanted due to stand loss (2015 tropical storm Bill – 12 inches rain in 12 hours)

2015 Historic Flood:

- 12 in (305 mm) 12 hours (Tropical Storm Bill - June)
- 35 in (889 mm) in 35 days (May-June)

Autumn 2015
Alfalfa
Summer-Dormant
Tall Fescue

Results: Cool-season Systems

2013-17	Value of gain	Total Gain	Revenue	Production Cost	Net Returm
5-yr avg.	$	lb acre^{-1}	$ acre^{-1}	$ acre^{-1}	$ acre^{-1}
Tall fescue-N fertilizer	0.8	340	272	133	139
W-A-C 2 paddock system	0.8	**424**	339	222	117
TF-wheat-TF system (20 bu wheat)	0.8	311	299	182	117
Tall fescue-Alfalfa*	0.8	343	275	162	113

Alfalfa was replanted due to stand loss (2015 tropical storm Bill – 12 inches rain in 12 hours)
We used amortized stand life of 3.5 years

Alfalfa-BG vs BG +/-N, +/- Supplements

Rotationally vs Continuously Stocked Systems

3 YR Avg (2016-18): Grazing days, SR, ADG, and TG:

Treatment	Stocking	Grazing days	Stocking rate	ADG	Grazing days /acre	Total gain
Bermudagrass:		days	AU/acre	lb/day	days/acre	lb/acre
800RR alfalfa	Continuous	168	1.4	0.99	231	228
800 RR alfalfa	Rotational	177	1.5	1.02	269	275
100 N	Continuous	138	2.0	0.45	282	127
100 N	Rotational	140	2.2	0.46	305	140
100 N + 0.5% suppl	Continuous	138	2.0	1.10	280	309
100 N + 0.5% suppl	Rotational	140	1.9	1.10	276	303
0 N	Continuous	131	1.6	0.41	215	89
0 N	Rotational	131	1.4	0.57	188	107
0 N + 0.5% suppl	Continuous	131	1.7	0.79	228	180
0 N + 0.5% suppl	Rotational	131	1.8	0.90	234	210
Monoculture:		**days**	**AU/acre**	**lb/day**	**days/acre**	**lb/acre**
800RR alfalfa	**Continuous**	**148**	**1.6**	**2.19**	**236**	**516**

Alfalfa rotationally vs continuously stocked – July, (second season)

3 yr old alfalfa stands:
60% rotation vs 15% continuously stocked

Grazing days, ADG, and TG: Avg 2016-18

Treatment	Rel Cost/yr	Grazing days	ADG	Grazing days /acre	Total Gain	Break-even COG
Bermudagrass:		AU/acre	lb/day	days/acre	lb/acre	
800 RR alfalfa	~75	186	1.01	250	251	0.49
100 N/A	~60	153	0.46	294	134	1.71
100 N/A + 0.5% BW supplement	~113	153	1.10	278	306	**0.55**
0 N/A	-	137	0.49	201	**99**	**-**
0 N/A + 0.5% BW supplement	~49	141	0.84	231	195	**0.51**

Averaged across 2016, 2017, 2018 and (continuously and rotationally stocked)

16 year summary for Alternative Forage-based Stocker Systems Evaluated at the Noble Research Institute

Production System	Study Years	Rain (%)	Grazing Initiation Date	Grazing Termination Date	Grazing Duration (days)	Grazing Days (head days)	Gain ADG (lbs/hd/day)	Total Gain (lbs/ac)	Value VOG ($/lb)	Gross Revenue ($/acre)	Tot Cost ($/ac)	Net Return ($/ac)
NF101 wheat/Impact Crabgrass	5 yr avg (2013-18)	114	12/16	8/19	164	288	1.9	549	0.80/0.6	400	213	187
800RR experimental alfalfa	3 yr avg 2015-18	110	3/13	11/25	148	236	2.2	517	0.80	413	241	172
Maton II rye/Marshall ryegrass	7 yr avg (2005-12)	82	11/18	4/28	130	183	2.3	421	0.80	337	183	154
Flecha summer dormant	5 yr avg (2013-18)	114	12/28	5/22	144	188	1.81	340	0.80	272	133	139
Chisholm summer-dormant	5 yr avg (2013-18)	114	12/28	5/22	145	185	1.77	327	0.80	262	127	135
TF-wheat-TF system (20 bu wheat)	5 yr avg (2013-18)	114	12/16	5/22	187	157	1.98	311	0.80	299	182	117
Wheat-Alf-CG (2 paddock) system	5 yr avg (2013-18)	114	9/18	8/19	127	210	2.02	424	0.80	339	222	117
Flecha-Alfalfa checkerboard mix	5 yr avg (2013-18)	114	11/19	5/20	103	154	2.23	343	0.80	275	162	113
Texoma MaxQII SATF	6 yr avg (2005-11)	78	1/24	6/9	116	157	1.9	298	0.80	238	133	105
NF101 wheat	5 yr avg (2013-18)	114	12/16	4/20	118	165	2.16	356	0.80	285	183	102
Alfagraze alfalfa	3 yr avg (2002-04)	89	4/29	9/16	140	204	2.1	420	0.80	336	237	99
Bermudagrass	3 yr avg (2008-10)	92	5/23	8/29	98	477	0.35	167	0.8	134	87	47

Factors affecting production and economics

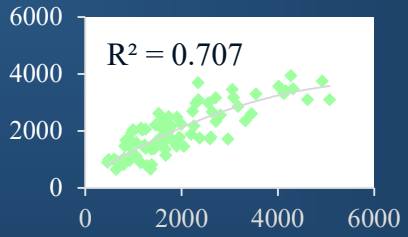
- Revenue
  - VOG
  - TG
    - Grazing Days, ADG
- Production Costs
  - Lime, P, K, B
  - Seed cost (RR vs Conv)
  - Pesticides (Insecticides)
- ✓ Stand life (Persistence)
  - Percent Stand

Summary and Conclusion: Grazing Research

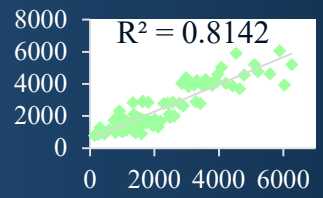
- Alfalfa/TF ($113) not as profitable as N fertilizer in Summer-dormant Tall Fescue ($139)
- Profitability (grazing alfalfa) is HIGHLY dependent on stand life (amortized over 3.5 yr stand life)
  - Rotationally stocked, summer deferment, and improved genetics (800RR) improved persistence
- Preliminary results suggest alfalfa MAY have potential in a Wheat/Alfalfa/Crabgrass year-round grazing system
- Preliminary results suggest alfalfa MAY have potential in Bermudagrass grazing systems (rotationally stocked)
- Current studies are on-going (6^{th} year; 4^{th} year of alfalfa)

Current Research - Technology

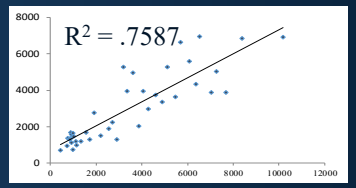
Develop high throughput phenotyping "Spider" system (biomass and CP) to assist plant breeders be more efficient.



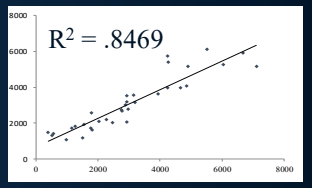
Alfalfa



Wheat

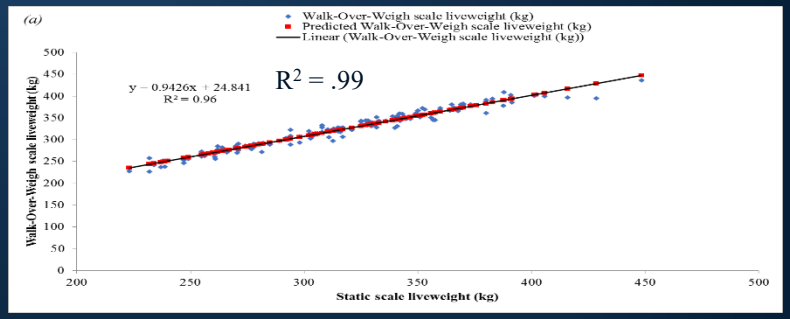


Tall fescue



Bermudagrass

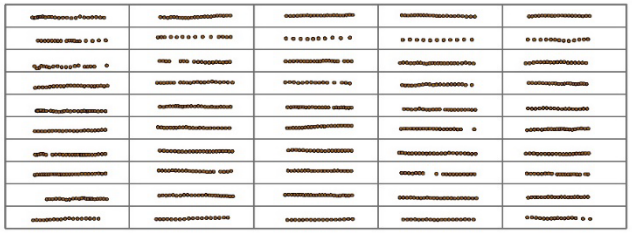
Develop automated walk-over-weighing system to collect daily animal weights

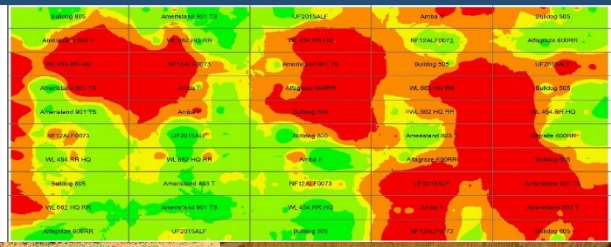


Develop automated forage tower system to collect daily biomass estimation – <u>still in development</u>

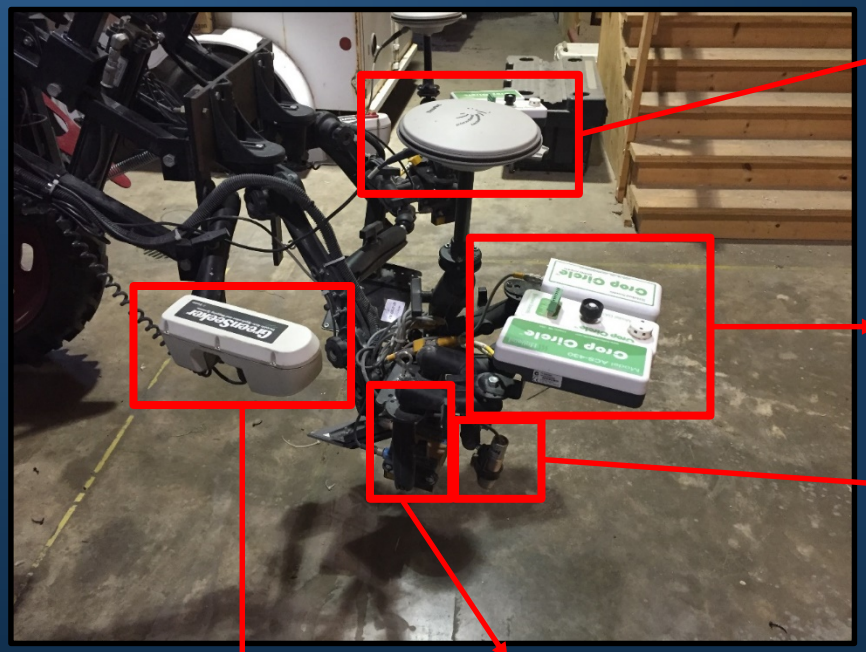
Tractor-Based Plant Phenotyping System

Bulldog 805	Ameristand 901 TS	UF2015ALF	Arriba II	Bulldog 505
Ameristand 803 T	WL 662 HQ RR	WL 454.RR.HQ	NF12ALF0073	Alfagraze 600RR
WL 454.RR.HQ	NF12ALF0073	Ameristand 901 TS	Bulldog 505	UF2015ALF
Ameristand 803 T	Arriba II	Alfagraze 600RR	WL 662 HQ RR	Bulldog 805
Ameristand 901 TS	Arriba II	Bulldog 505	WL 662 HQ RR	WL 454.RR.HQ
NF12ALF0073	UF2015ALF	Bulldog 805	Ameristand 803 T	Alfagraze 600RR
WL 454.RR.HQ	WL 662 HQ RR	Arriba II	Alfagraze 600RR	Bulldog 505
Bulldog 805	Ameristand 803 T	NF12ALF0073	UF2015ALF	Ameristand 901 TS
WL 662 HQ RR	Ameristand 901 TS	WL 454.RR.HQ	Arriba II	Ameristand 803 T
Alfagraze 600RR	UF2015ALF	Bulldog 505	NF12ALF0073	Bulldog 805





Spider Platform Specifications



Trimble/OmniStar GNSS-enabled GPS System

Holland Scientific Multi-Parameter Sensors

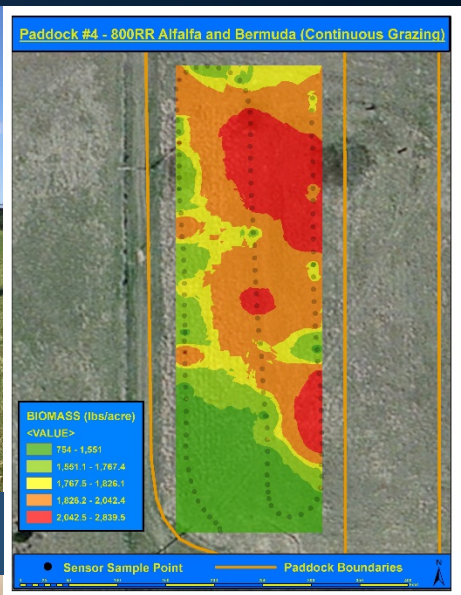
- Crop Circle Model ACS-430
- Crop Circle Model DAS43X
- Crop Circle Model ACS-470

120 Mhz Ultrasonic Distance Sensor

Trimble Greenseeker

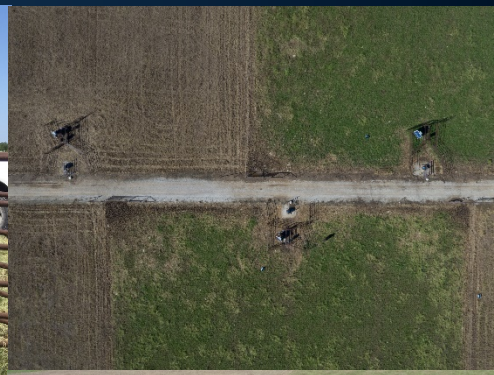
(2)Time-Of-Flight Lasers

Driver Seat View



ForageBox System







Walk-Over-Weigh Livestock Systems

1. Weight Data Controller
2. Radio Transmitter
3. EID Data Controller
4. Dual EID Antenna Adapter
5. Power Inverter
6. Solar Charger Controller

Electronics & Power System

Water Source

Wireless Connectivity

Xetawave Xeta9 Series dual-band 902-960 Mhz software-defined radio

Scale Load Bars

Walk-Over-Weigh Platform

EID Reader Panels

DATE_TIME_STAMP	LOCATION	WEIGHT	RFID
10/1/2018 17:54	PADDOCK#3	292	982 000421539332
10/1/2018 18:28	PADDOCK#5	306	982 000421539260
10/1/2018 19:32	PADDOCK#18	652	982 000421539391

WOW Data Output Example



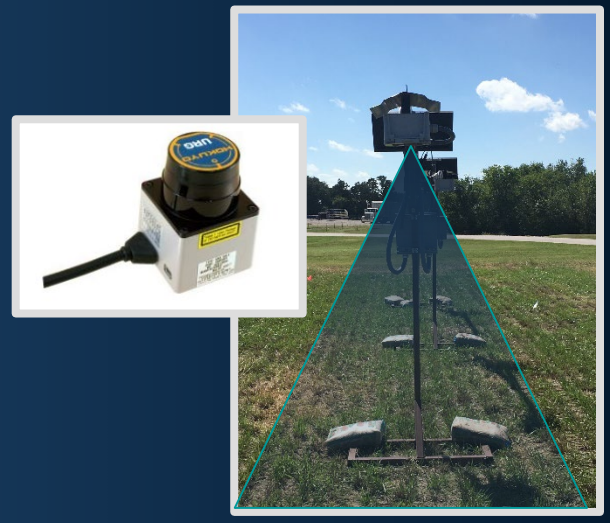
Forage Tower Systems

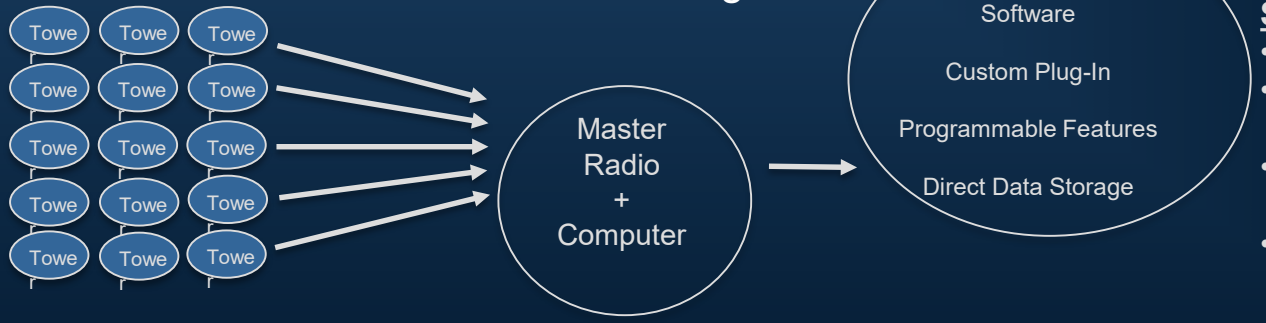



Forage Tower System

System Components:

- Hokuyo URG-04LX Scanning Laser Rangefinder
  - Distance Data Output
  - Programmable Data Retrieval Angles
    - Example: 45º x 45º angle = 256 height measurements per second (mm)
- Xetawave Xeta9 Series Dual-Band 902-960 Mhz Software-Defined Radio
- Solar Power System
- Metal-Fabricated Mobile/Flexible Design





Advanced TCP/IP Software

- Data Retrieval Angle
- ON/OFF Retrieval Times
- Retrieval Duration Time
- Data Storage (.csv)

Summary and Conclusion: Technology

- High throughput phenotyping system tremendous tool for plant breeding
- Walk-Over-Weighing (in pasture) effective tool to replace traditional static scales
  - Daily weight will allow for greater management decision tools
- Forage Towers are still under development
  - Daily forage biomass will allow for modeling and contribute to decision support tools
- Technology development is continually under development and is constantly changing

Future Research

Russian wheatgrass

Hybrid tall fescue

Cover cropsw

Questions?