Technology & Techniques In Applied Beef & Forage Systems

H.A. (Bart) Lardner

Professor

Ministry of Agriculture

Strategic Research Program Chair

Cow-Calf & Forage Systems

University of Saskatchewan


STAY CONNECTED
YouTube
twitter
@DrBart_Beef
APPLIED BEEF &
FORAGE SYSTEMS
RESEARCH
06/21/2012 09:56

Research in Management Practices Including Breeding, Weaning, Calving, Feeding And Grazing

Animal - Plant - Soil - Water Interfaces

Evaluate Forage Persistence, Digestibility and Nutrient Availability

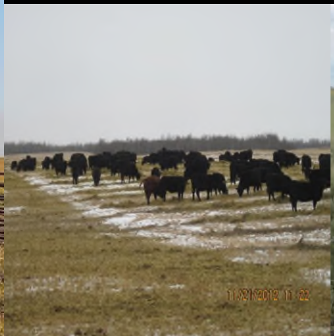
Extensive Systems & Forages That Enhance Cow Reproductive Efficiency

Impact on Soil Health, Soil Moisture, Carbon Sequestered and Enteric Emissions

Explore Synergies Between Sask Beef Industry & Environment








WesternBeef
DEVELOPMENT CENTRE

25 years at WBDC

2018 to LFCE

Livestock & Forage Centre of Excellence
Forage and Cow-Calf Unit
University of Saskatchewan

UNIVERSITY OF SASKATCHEWAN

Saskatchewan's
Growth Plan
The Next Decade of Growth | 2020-2030

Increase Crop Production to 45 M tonne

Increase Livestock Cash Receipts to $3 billion

INTEGRATED COW-CALF & FORAGE SYSTEMS

INCREASE USE OF FORAGES IN BEEF CATTLE DIETS

EVALUATE FORAGES THAT ENHANCE GROWTH AND REDUCE EMISSIONS

Teff grass (*Eragrostis tef*)

Forage Chicory

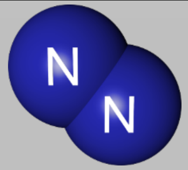
Perennial And Annual Forages

Russian wildrye
tall fescue
smooth bromegrass
meadow bromegrass
hybrid bromegrass
crested wheatgrass
orchardgrass
cicer milkvetch
sainfoin
alfalfa
birdsfoot trefoil

ryegrass
fall rye
barley
oat
millet
corn
Brassicas
berseem clover
teff grass
faba
soybean

Benefits - Legumes

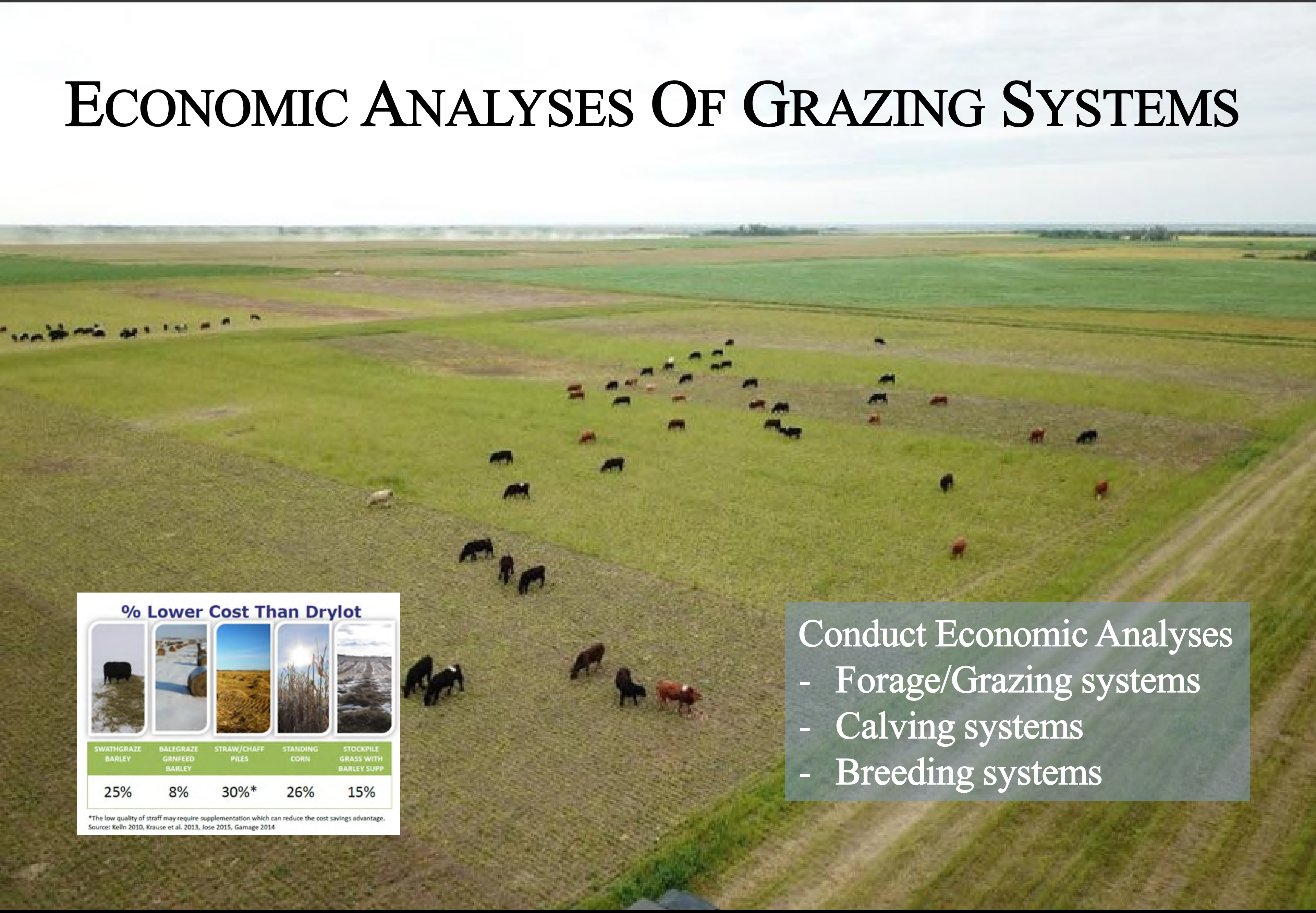
N_2 is nearly 80% of Atmosphere



Systems Approach With Legumes & Livestock

Integrate Crops & Livestock – Lower Inputs

ECONOMIC ANALYSES OF GRAZING SYSTEMS



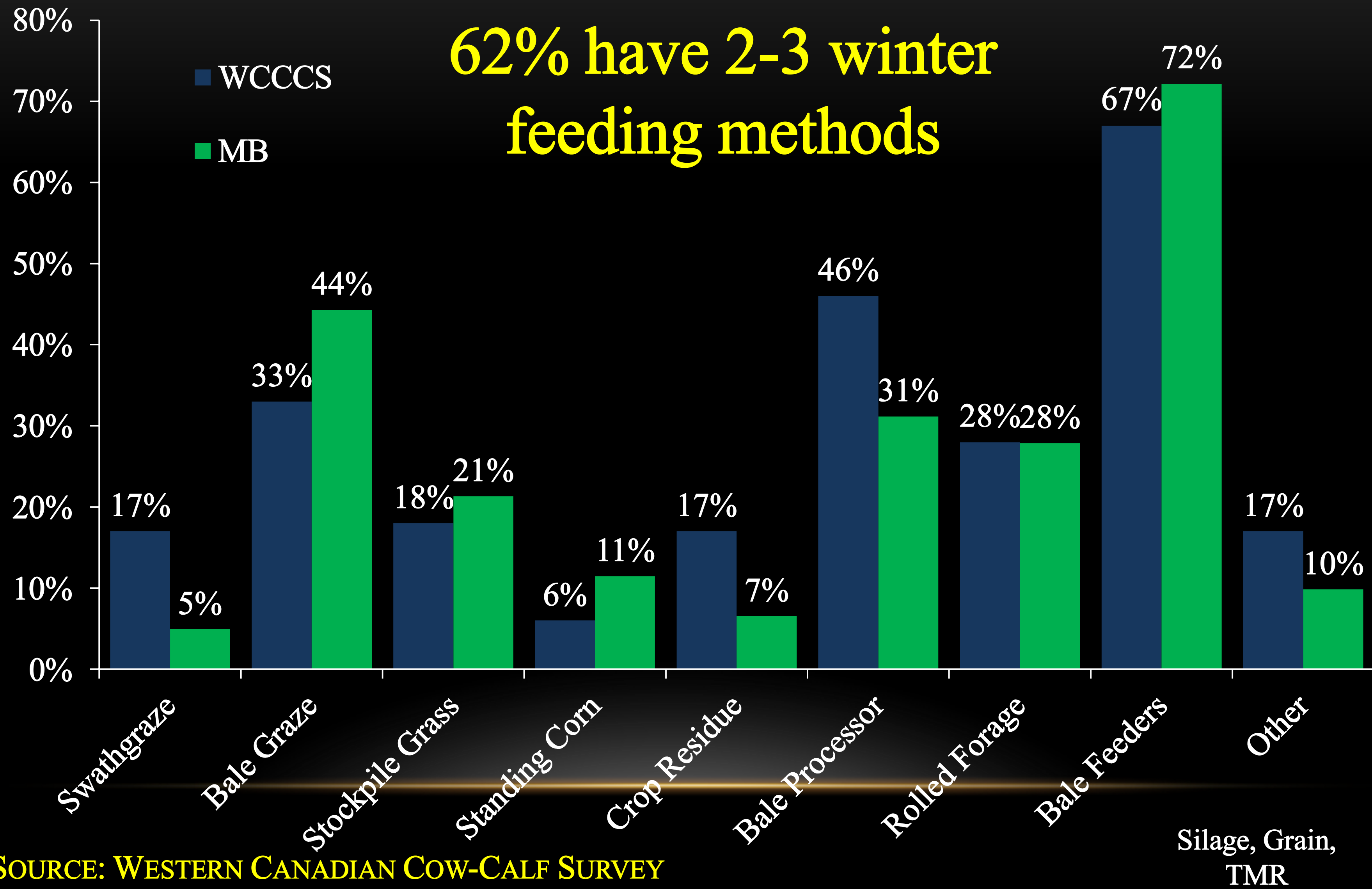
Conduct Economic Analyses
- Forage/Grazing systems
- Calving systems
- Breeding systems

Increase Use of Forages in Beef Cattle Systems

Forages are "Foundation of Beef Industry"

Target to graze as many days a year…….

Extensive Winter Systems



Source: Western Canadian Cow-Calf Survey 2017; Larson 2021


What you want to see…….

What you don't want to see…….

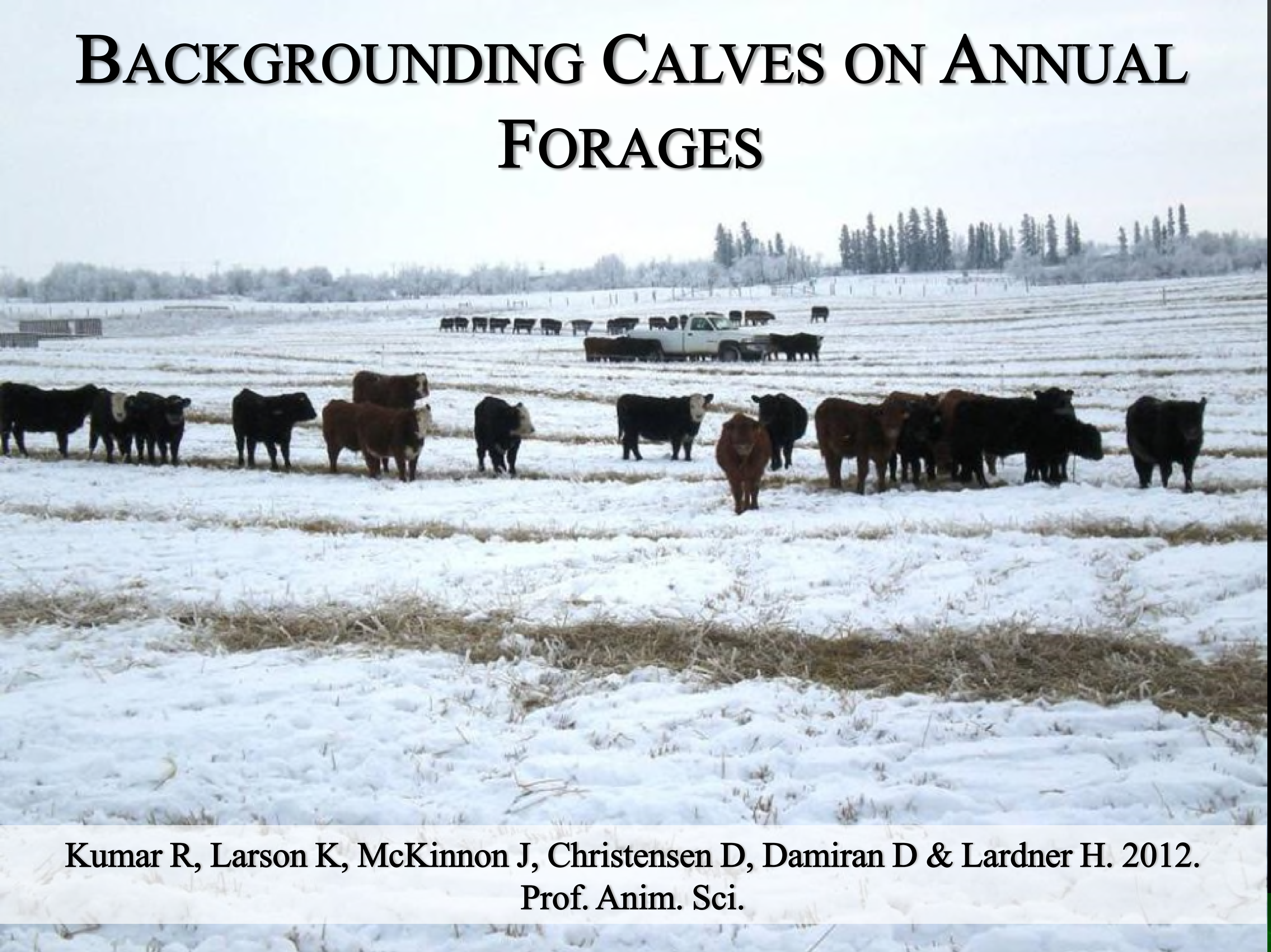
November 13 2006

Be prepared – Plan B!

EXTENSIVE BACKGROUNDING PROGRAMS
WHY?

High ‘cost of gain’ in Drylot

Backgrounding Calves on Annual Forages



Kumar R, Larson K, McKinnon J, Christensen D, Damiran D & Lardner H. 2012. Prof. Anim. Sci.

Backgrounding Phase

3 year study

- 360 fall-weaned calves allocated to 1 of 3 replicated (n=2) backgrounding systems (October)

  1. Swath graze Golden German millet
  2. Swath graze Ranger barley
  3. Drylot processed grass-legume diet

- Field allocated forage every 3 days
- Supplement at 5 lb/d (0.6% BW)

FEEDLOT PHASE

- Calves finished at University of Saskatchewan Beef Cattle Research Unit (March)

- Calves adapted to starter diet of 60% silage
- Finishing ration of 20% roughage 80% barley

- Calves finished to backfat of 12 mm
- Performance and carcass data collected

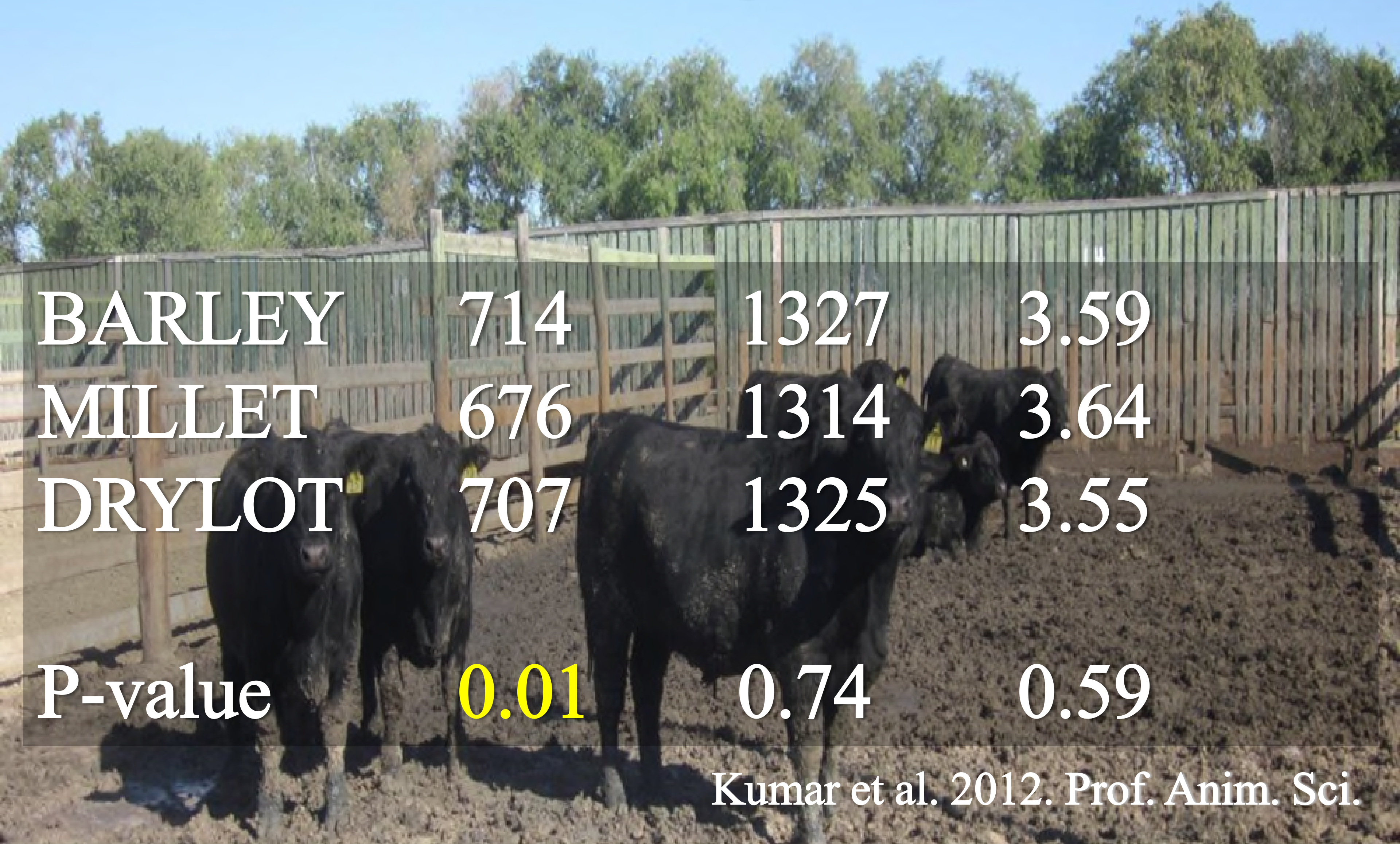
BACKGROUND PERFORMANCE

BARLEY	456	635	1.8
MILLET	456	593	1.3
DRYLOT	458	639	1.8
P-value	0.99	0.01	0.01

Kumar et al. 2012. Prof. Anim. Sci.

Steer Feedlot Performance

Final Live Weight and ADG



BARLEY	714	1327	3.59
MILLET	676	1314	3.64
DRYLOT	707	1325	3.55
P-value	0.01	0.74	0.59

Kumar et al. 2012. Prof. Anim. Sci.

Table 7. Effect of b... cost of gain in background over 3 yr

Ite...	...lue
Feed c...	...0.040
Yarda...	...0.001
Tot...	...01
Cost of gain, $/kg ... .160	0.001

[a,b]Means within a ...

[1]BAR = swathed barley grazing; MILL = ...ed millet grazing; DL = drylot pen feeding.

Cost of gain to background calves on barley swath graze was 41 and 43% lower than on millet swath graze or drylot, respectively

Kumar et al. 2012. Prof. Anim. Sci.

Benefits Of
Retaining & Backgrounding Strategies For Beef Calves

This $126,500 ADF & SCA funded project evaluated extended backgrounding on forages compared to drylot feeding

Ranger Barley Swath Grazing
Saskatchewan Producer Benefits
$54 million
($0.68/hd/d)

Golden German Millet Swath Grazing
Saskatchewan Producer Benefits
$44 million
($0.55/hd/d)

800,000 calves

Crop Residue Grazing Research

Whole Buncher Collects Residues

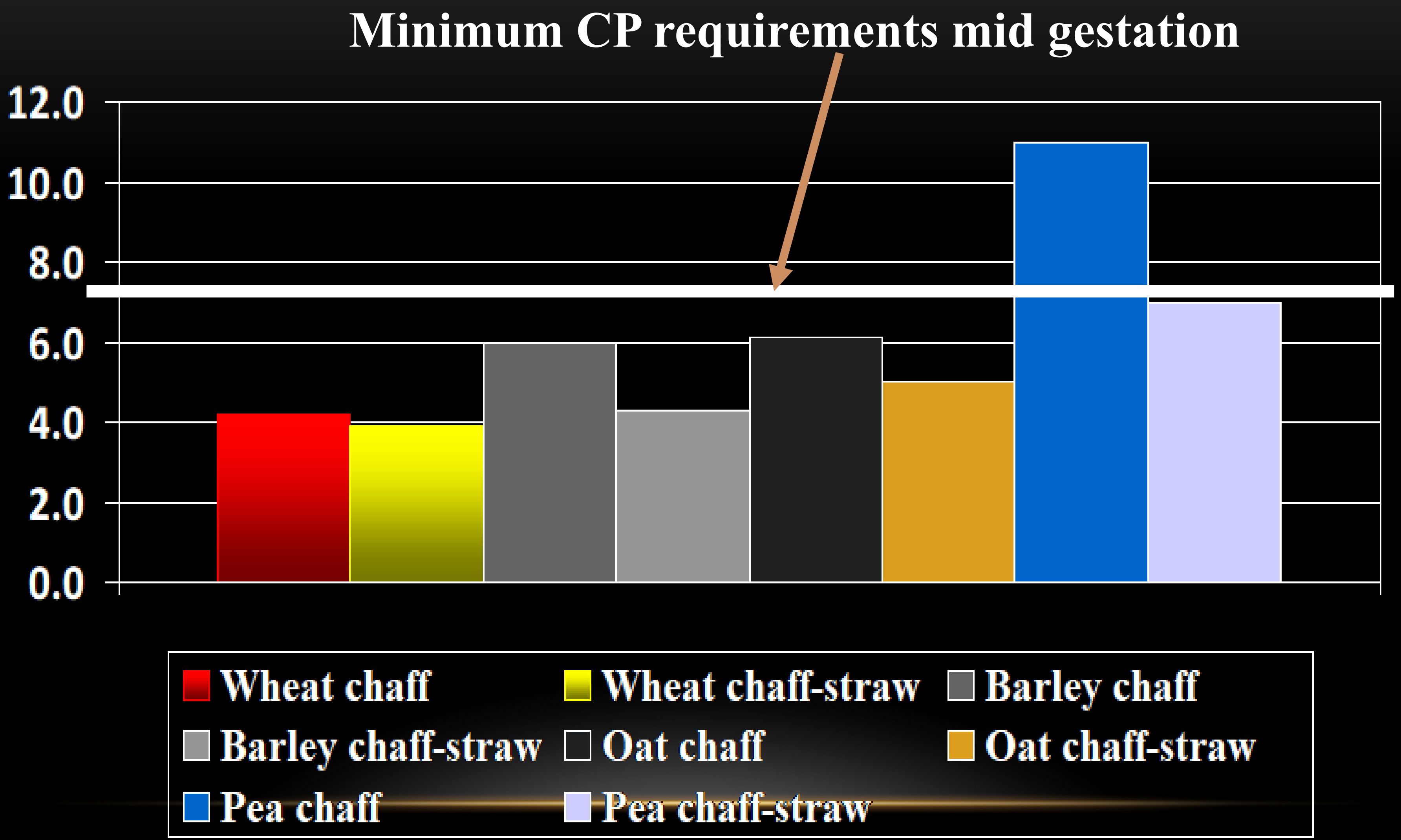
Cereal, pulse, oilseed, cool, warm season crops

- Straw, chaff, husk, hulls, off-grains post-harvest

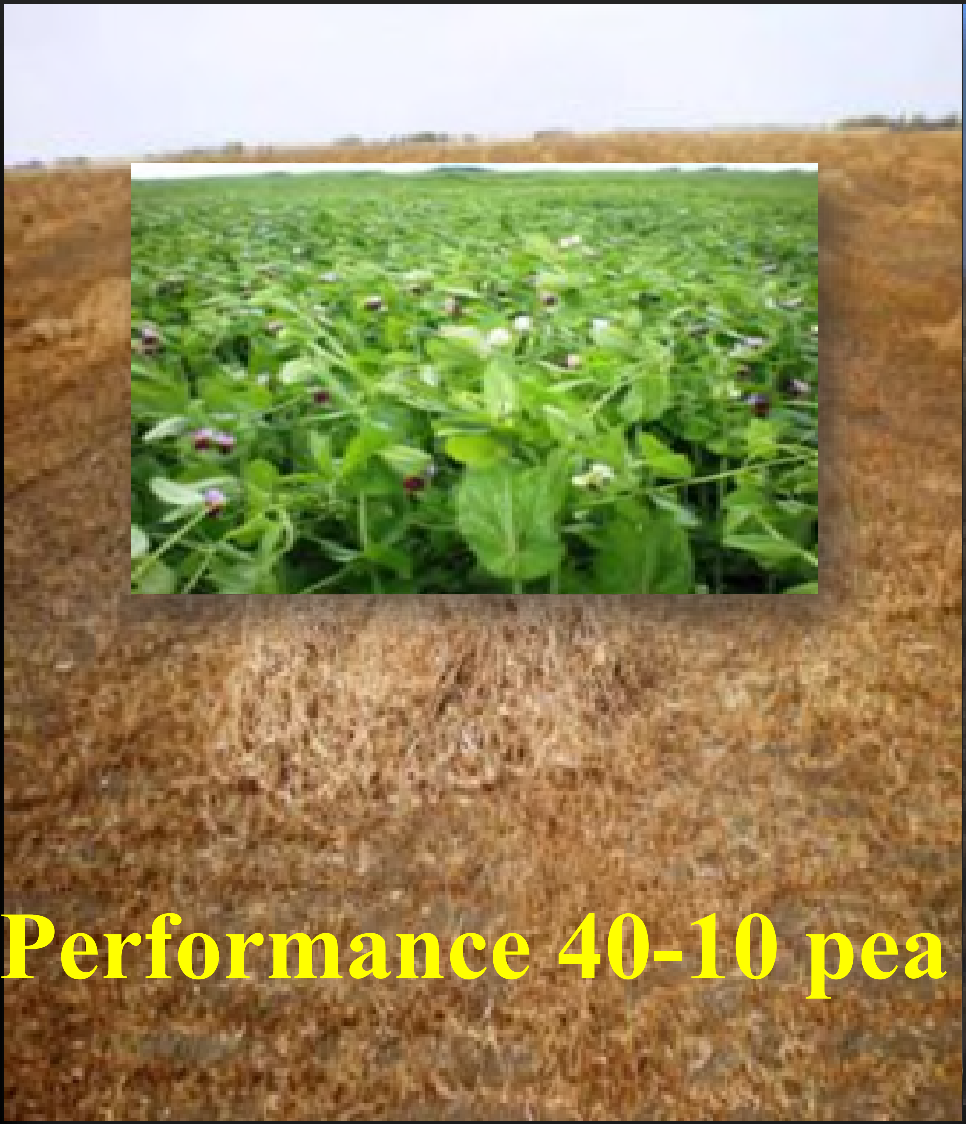
Barley Residue (Van De Kerckhove et al. 2011)

Oat and Pea Residues (Krause et al. 2013)

Average Chaff and Chaff Straw Crude Protein Values

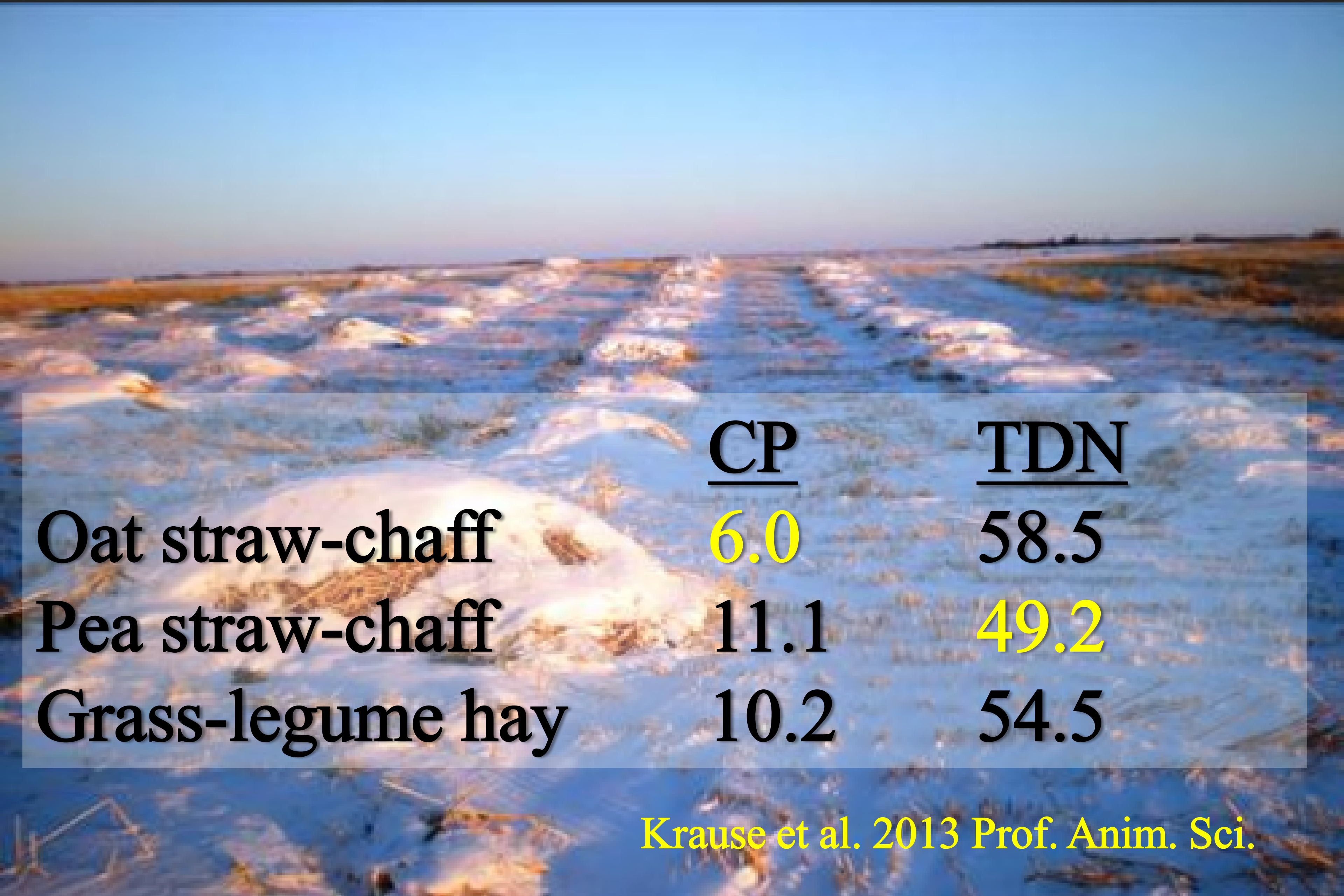


Grazing Pea and Oat Residues



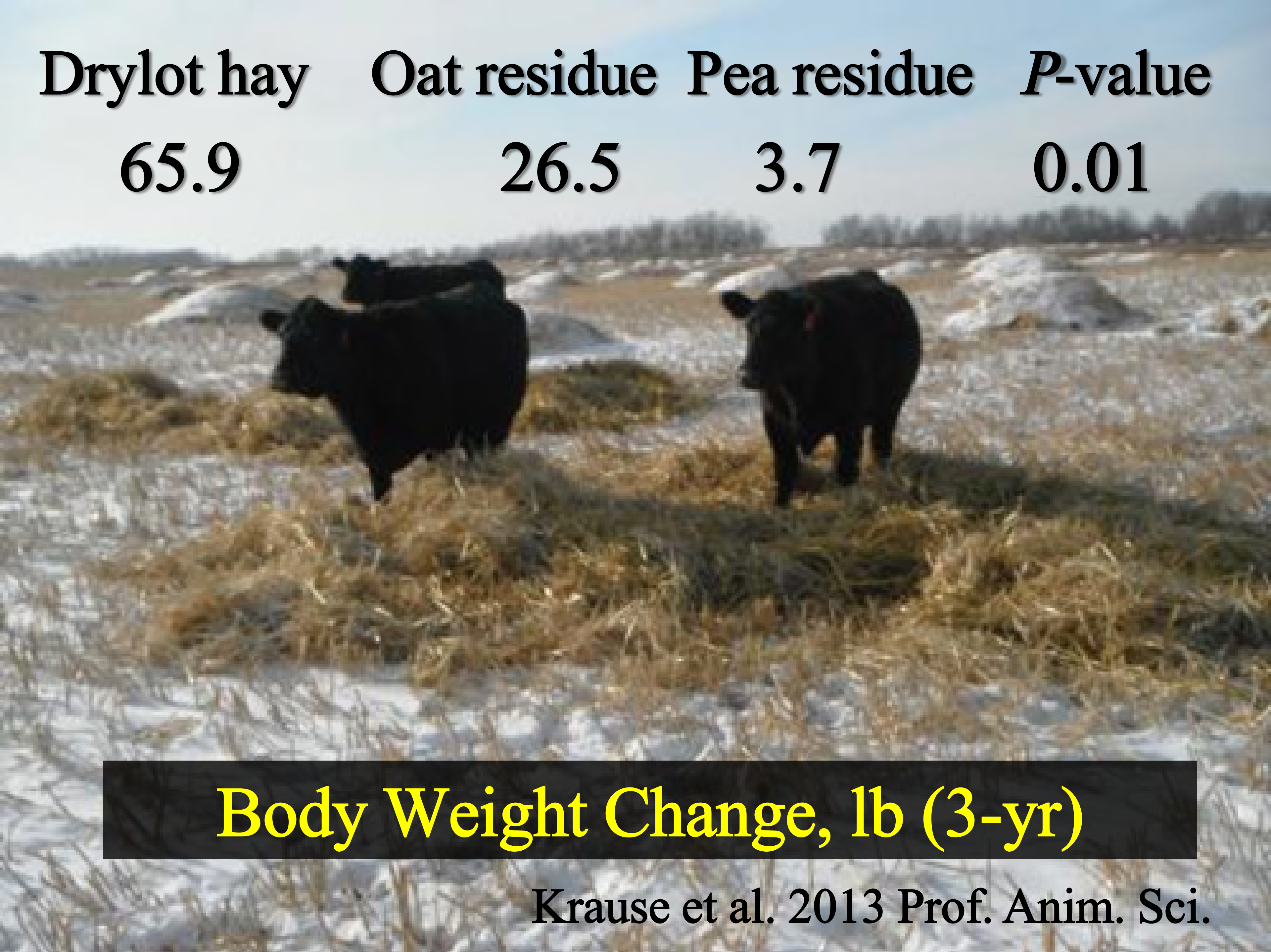
Krause et al. 2013. Prof. Anim. Sci.

Nutritive Value Straw-Chaff



	CP	TDN
Oat straw-chaff	6.0	58.5
Pea straw-chaff	11.1	49.2
Grass-legume hay	10.2	54.5

Krause et al. 2013 Prof. Anim. Sci.



Drylot hay	Oat residue	Pea residue	*P*-value
65.9	26.5	3.7	0.01

Body Weight Change, lb (3-yr)

Krause et al. 2013 Prof. Anim. Sci.

Table 6. Economic analysis of winter feeding systems over 3 yr ($/cow per day)

Grazing Oat or Pea residues was 42 and 34% lower cost than Drylot, respectively

Yardage cost	0.34	0.30	0.32	0.016	0.23
Total cost	2.13[a]	1.36[b]	1.53[b]	0.110	<0.01

[1]DL = drylot pen feeding with brome-alfalfa hay; OAT = grazing oat residue in field paddocks; PEA = grazing pea residue in field paddocks.

[ab]Means (n = 9) within a row with different superscripts differ ($P < 0.05$).

Krause et al. 2013 Prof. Anim. Sci.

CONCERNS
EXTENSIVE WINTER GRAZING

Effects of in-field bale grazing compared to non grazed site on nutrients in spring snowmelt runoff water

A Smith, J Schoenau, J Elliott and HA Lardner

- Evaluate soil and water nutrients - pre- and post-grazing from wintering site landscapes
- Develop management strategies to mitigate impact of nutrients from wintering sites

Smith et al. 2010 Water Sci. Tech.

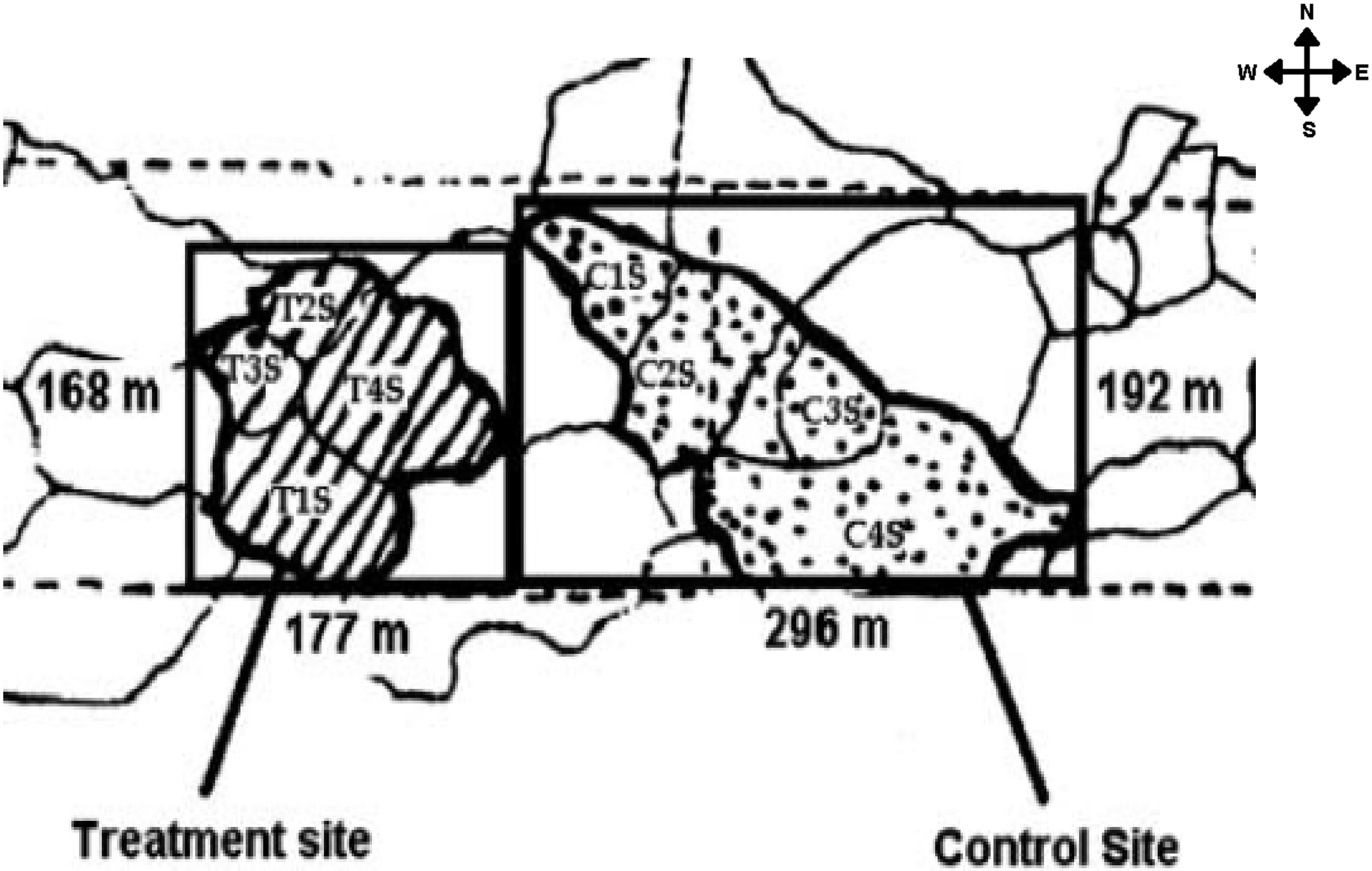


Figure 1 | Site map of basins separated into control site and treated (winter feeding) site.

Smith et al. 2010 Water Sci. Tech.

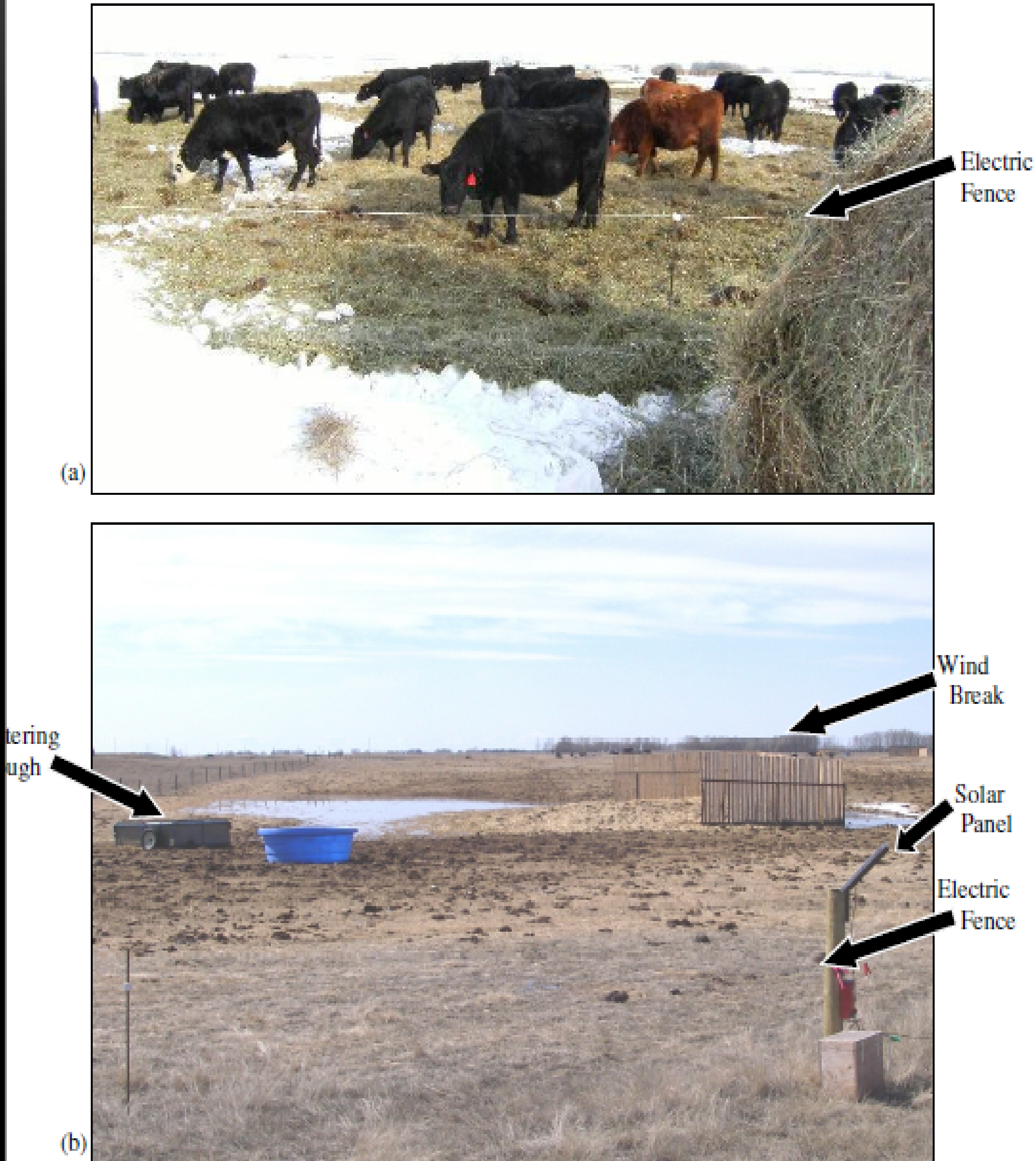


Figure 3.8 Winter feeding site (a) limited access to bales with electric fence (b) winter feeding site with electric fence, solar panel, windbreak, water trough.

Measuring water depth in piezometer.

COLLECTED WATER SAMPLES
PIEZOMETERS AT 5 M DEPTH
SURFACE RUNOFF SAMPLES

Smith et al. 2010. Water Sci. Tech.

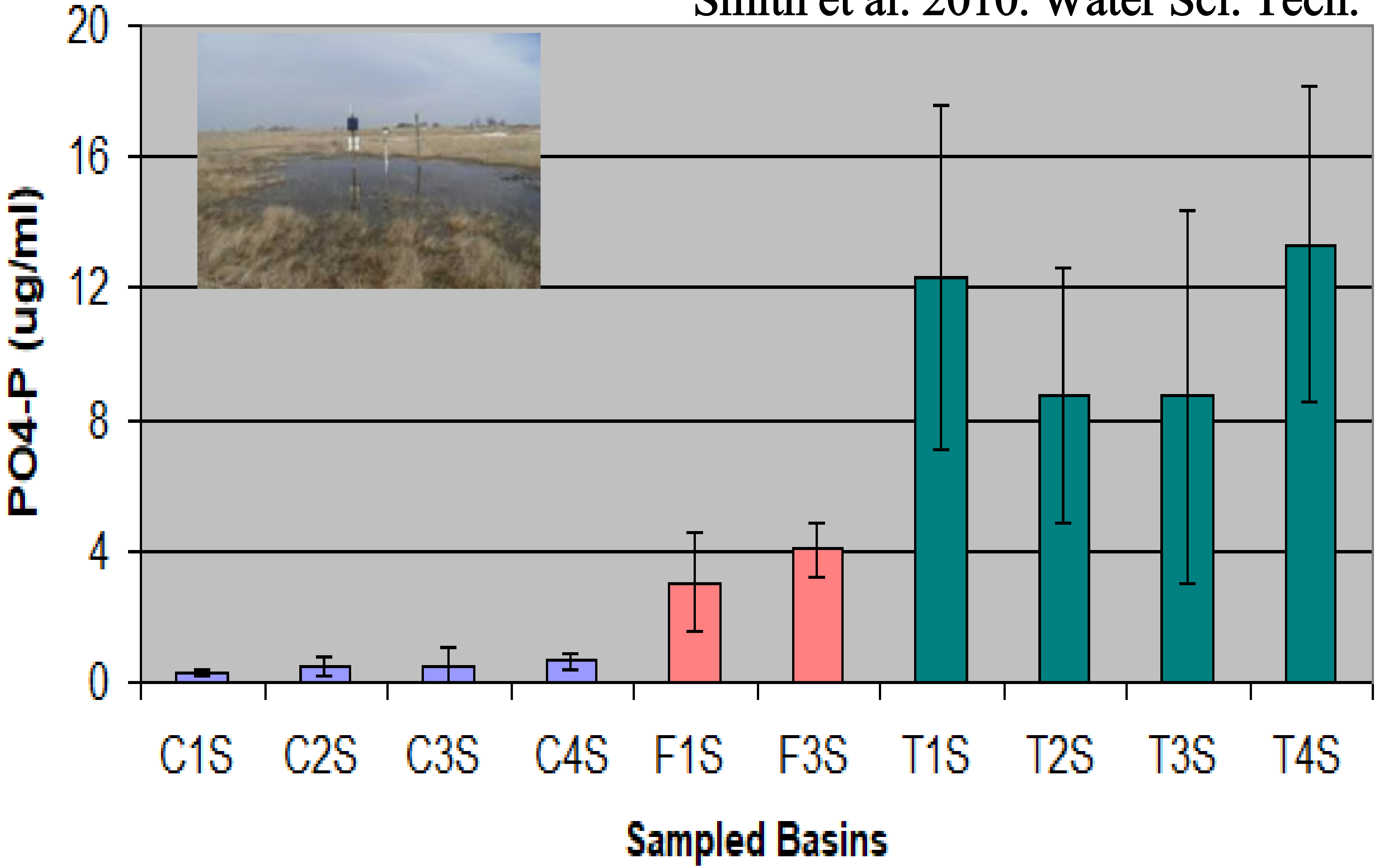


Fig.1 Average orthophosphate (SRP) concentration from surface runoff water
31 March to April 2009. C=Control F=Farmyard T=treatment

AVOID BALE GRAZING NEAR WATERWAYS

That is the early advice from researchers looking at coliform bacteria, nitrogen and phosphorus levels in runoff from winter grazing sites

BY DEBBIE FURBER

Time and time again producers attest to the benefits of winter bale grazing out on pastureland. Not only does it eliminate the cost of starting a tractor to feed bales and clean corrals, but they see that the manure and urine deposited by the animals, along with litter from the bales is greatly improving the organic matter in the soil, resulting in a marked increase in forage production.

As of yet, there have been no best management practices established for in-field winter feeding systems, largely because there hasn't been enough research carried out to determine the long-term impact of the nutrient load on the land, groundwater and surface waterbodies in the watershed areas near in-field winter feeding sites.

Trials at two locations in Saskatchewan are assessing the concentrations and export of nitrogen and phospho-…

bale grazing sites at both locations, the early recommendation is to situate bale-grazing areas so that run-off doesn't enter sensitive surface and subsurface waterbodies.

WBDC STUDY

The winter bale-grazing site at the WBDC was set up in the fall of 2008 on rolling perennial pastureland that had not previously been used for winter bale grazing. This three-year study involved two bale-grazing sites, with the cattle returning to the first site in the third year of the study.

The bales were placed 30 feet apart on centre to average 23 bales per acre. During the first winter, a group of 80 to 105 cows was bale grazed from Dec. 8 through Mar. 6. The bales were mostly bromegrass with five to 10 per cent alfalfa.

The bale-grazing density of 887 cow days per acre added an estimated 248 tons of manure to the site during the first winter grazing period. Of that total, 1.26 tons would have been in the form of nitrogen, for an application rate of 281 pounds per acre. Phosphorus totalling 0.42 tons was deposited at the rate of 94 pounds per acre.

A number of low-lying areas in the pastures where water tends to gather during run-off times (micro-watershed basins) have been established to monitor surface run-off water on the …

SOIL SAMPLES

… from a depth of six inches were taken across a large grid in the area to be used for bale grazing. Soil samples from the same … after the first wi… the spring of 200…

Compared w… winter feeding h… on soluble and exchangeable soil phos-…

Researchers retrieve groundwater samples a piezometer at the Western Beef Development Centre site.

… the piezometers in the control areas. Orthophosphate is a basic form of …

… ence wasn't statistically significant.

… from the bale-grazed site was elevated in comparison with the control site as well.

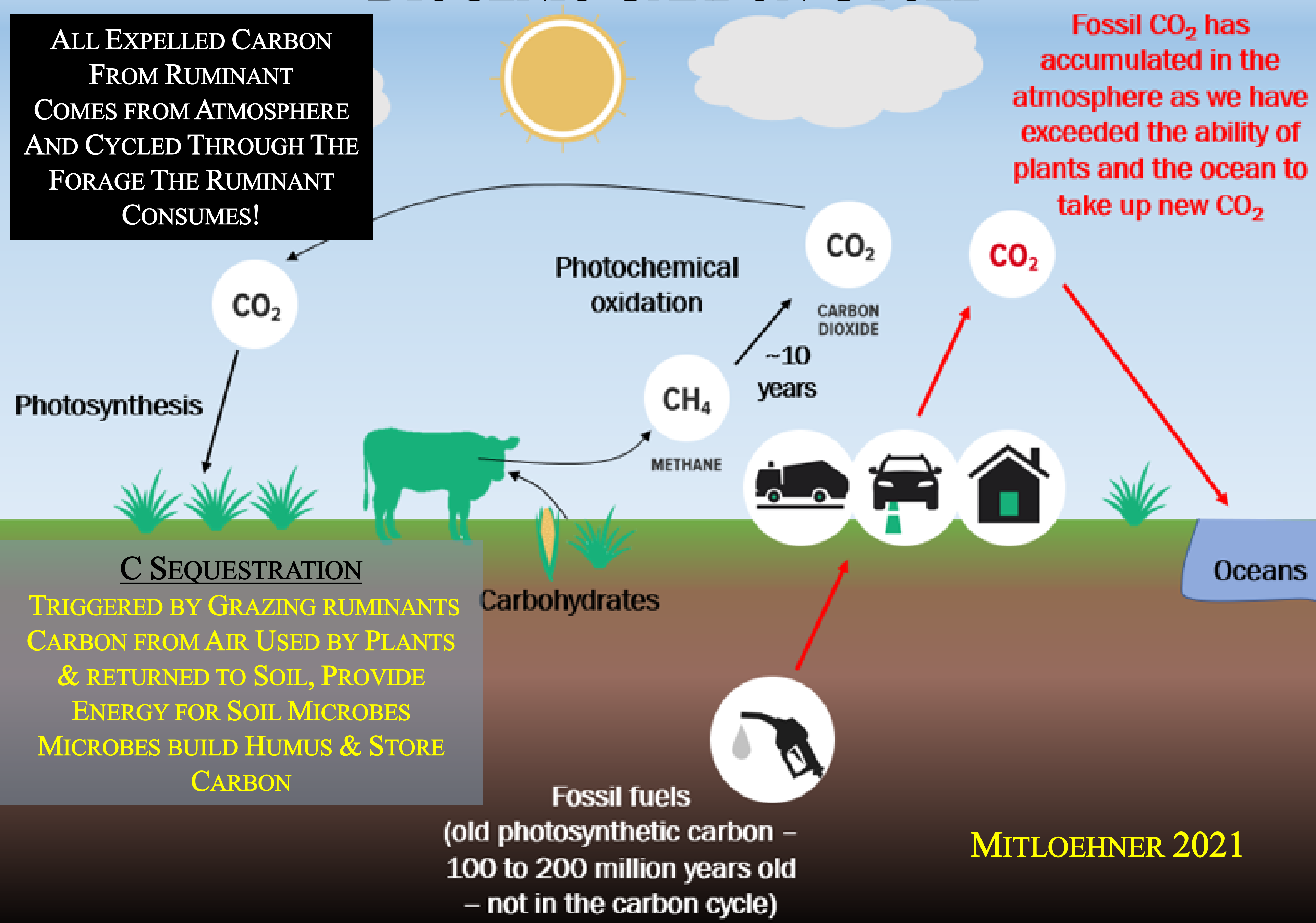
… than from the bale-grazed site. The

Winter feed on nutrient deficient areas on farm/ranch

Defer area -1 to 3 year – depending on cow density

CANADIAN CATTLEMEN - SPRING 2011

Biogenic Carbon Cycle



Measuring Emissions with SF6 Technique

Animal Science Grad Students

Measure CH_4 & CO_2 with SF6

Improving Value of Grazed Forages Impact On GHG Emissions

Automated Head Chamber System (GreenFeed, C-Lock Inc.)

Perennial & Annual Forage Systems

Forage Systems

- 66-hectare (165 acre) field site
- 4 treatments, 3 replicates
- Each paddock is approximately 6 ha

Meadow bromegrass + Sainfoin (MBGSF)	Fall Rye + Clover	Hybrid bromegrass + Alfalfa
Hybrid bromegrass + Alfalfa (HBGALF)	Hybrid bromegrass + Alfalfa	Barley + Peas + Brassicas
Fall Rye + Clover (FRCLOV)	Meadow bromegrass + Sainfoin	Fall Rye + Clover
Barley + Peas + Brassicas (BRPEABRAS)	Barley + Peas + Brassicas	Meadow bromegrass + Sainfoin

Forage Biomass & Quality
Animal Performance & Emissions
Soil Characteristics
Soil Water Balance
Soil Microbial Communities
System Economics

Wasden et al. 2021 (unpublished)

Determine Soil Water Balance Under Forage Systems

Soil Moisture Probes
0.2, 0.4, 0.6, 0.8, 1.0, 1.5 M Depths

Soil Matrix Water Potential Continuously Measured With Heat Dissipation Sensors

Fonstad, T, Rinas C and Sammons J

Effects of forage systems on forage quality and enteric emissions

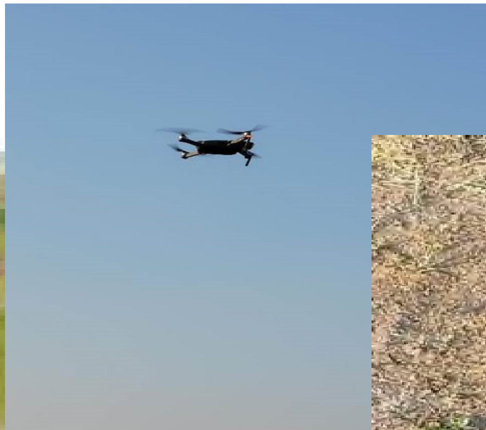
M Wasden[1], G Ribeiro[1], D Damiran[1], B Biligetu[2], K Larson[3] and H.A. Lardner[1]

	Perennial		Annual			
	HBGALF	MBGSF	FRCLOV	BRPEABRAS	SEM	*P*-value
DM, %	51.1	55.3	35.1	51.2	6.55	0.14
CP, %	8.0^{bc}	5.9^{c}	13.1^{a}	11.2^{ab}	1.01	<0.01
NDF, %	66.5^{a}	67.5^{a}	44.6^{c}	54.9^{b}	2.06	<0.01
ADF, %	44.4^{a}	43.6^{a}	30.5^{b}	32.5^{b}	1.90	<0.01
TDN, % of DM	53.8^{b}	55.0^{b}	61.1^{a}	62.6^{a}	1.37	<0.01
CH_4 emission, g/kg DMI	17.3^{a}	12.0^{b}	14.9^{a}	15.7^{a}	0.69	<0.01

^{a,b,c}Means with different letters in the same row are significantly different ($P \leq 0.05$). Letter group assigned using Tukey multi-treatment comparison method at the 5% significance level.

GRAZING PREFERENCE OF FORAGES AS MONOCULTURE OR BINARY MIXTURES

Grazing Preference Observations



UAV Technology 'Wilson II' Drone

Visual Observation (modified Lardner et al. 1994)

7 d per Grazing Period
2 h in AM and PM

FORAGE PREFERENCE RANKING OVER 2 YR

A	Foothold alfalfa 3006 alfalfa
AB	Cronus alfalfa
ABC	Cronus alfalfa + AC Armada MBG AC Mountainview sainfoin
ABCD	Foothold alfalfa + AC Armada MBG
BCD	AC Armada MBG 3006 alfalfa + Killarney OG
CD	AC Mountainview sainfoin + Killarney OG AC Mountainview sainfoin + AC Armada MBG 3006 alfalfa + AC Armada MBG Foothold alfalfa + Killarney OG Cronus alfalfa + Killarney OG
D	Killarney OG

$P<0.05$

Sim et al. unpublished

SUMMARY

Differences in graze preference related to forage biomass and quality

Alfalfas most preferred; correlates with higher yield, protein and low fiber

Killarney orchardgrass least preferred, lowest yielding

Winter Extensive Grazing Systems

Grazing Cover Crops

Soil Health, Graze Capacity and Cost

Growing Multiple Species Together
Suggested Increased Biodiversity
Increase biomass
Increase 'Soil Health'
Reduce Inputs

Annual legumes - hairy vetch (30%), crimson clover (10%)

Cool season - Italian ryegrass (25%)

Warm season - sorghum (15%), millet

Brassicas - Winfred turnip-kale (10%), Graza/Hunter turnip (10%)

Pulse - forage pea

Drieschner et al. 2019 (unpublished)

Grazing PolyCrops At LFCE

Treatments
- Haymaker Forage Oat
- Four Specie Mix (oat, pea, brassica, vetch)
- Eight Specie Mix (oat, barley, pea, brassica, vetch, teff, Chicory, Millet)

Biomass/Quality
Cow Performance, Economics
Soil Characteristics, Enteric Emissions

Robinson et al. 2022

Measure GHG
Fall/Winter Temps

Eddy Covariance Flux Towers
Measure Methane Flux From Collared Cows
AAFC Staff – Alemu, Coates, Coulombe

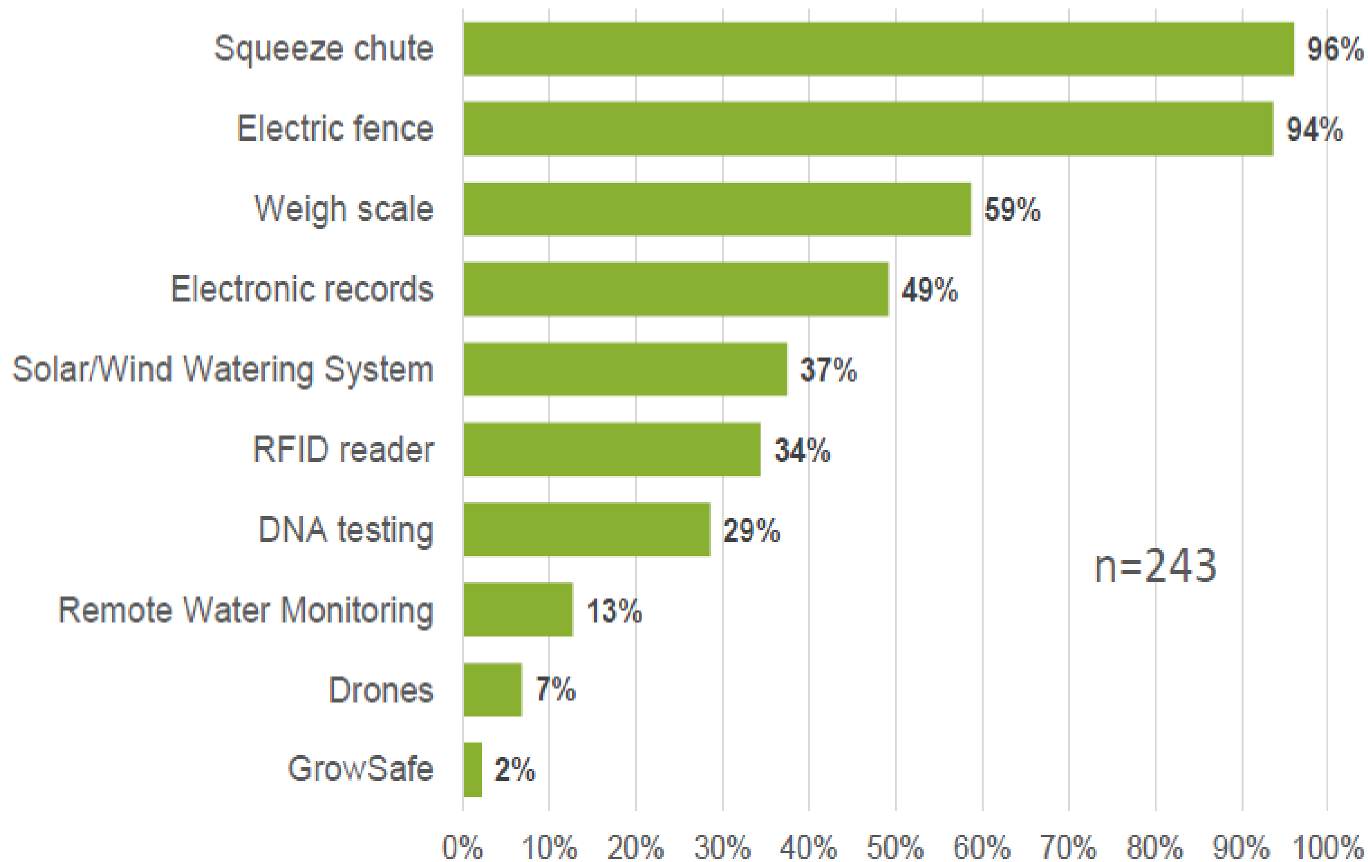
Grazing Complex Mixtures In Saskatchewan Summary

Growing Multiple Species Together – Lanigan Saskatchewan Suggests Increased Biodiversity…

- Increased biomass
- Increase 'Soil Health'
- Improved Soil Organic Carbon – Greater Root Biomass

Drieschner et al. 2019

Technology Adoption



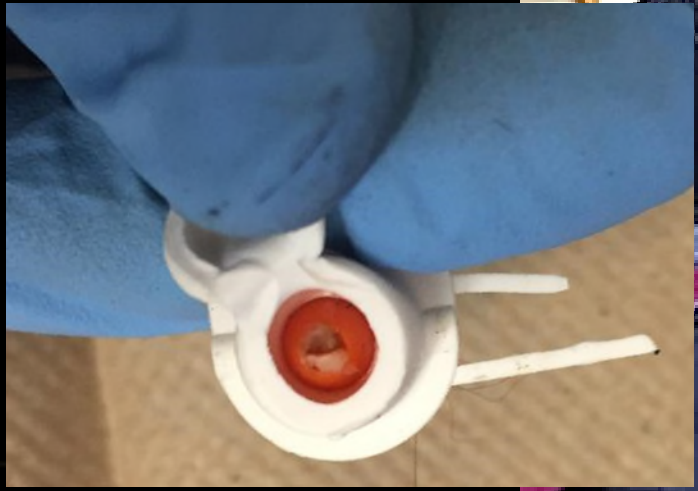
SOURCE: WESTERN CANADIAN COW-CALF SURVEY 2017; LARSON 2021

Using DNA Parentage In Multi-Sire Breeding Systems

University of Saskatchewan

Sire Verification

- DNA samples analyzed by Quantum Genetix Ltd.
- DNA extraction using sodium hydroxide lysis or paramagnetic bead DNA extraction
- 100 SNP panel



Does It Pay?

Ways to create value

- Prevent dystocia
- Increase pounds of calf weaned
- Better selection of replacement heifers
- Reduce number of non prolific sires

NUMBER OF CALVES SIRED

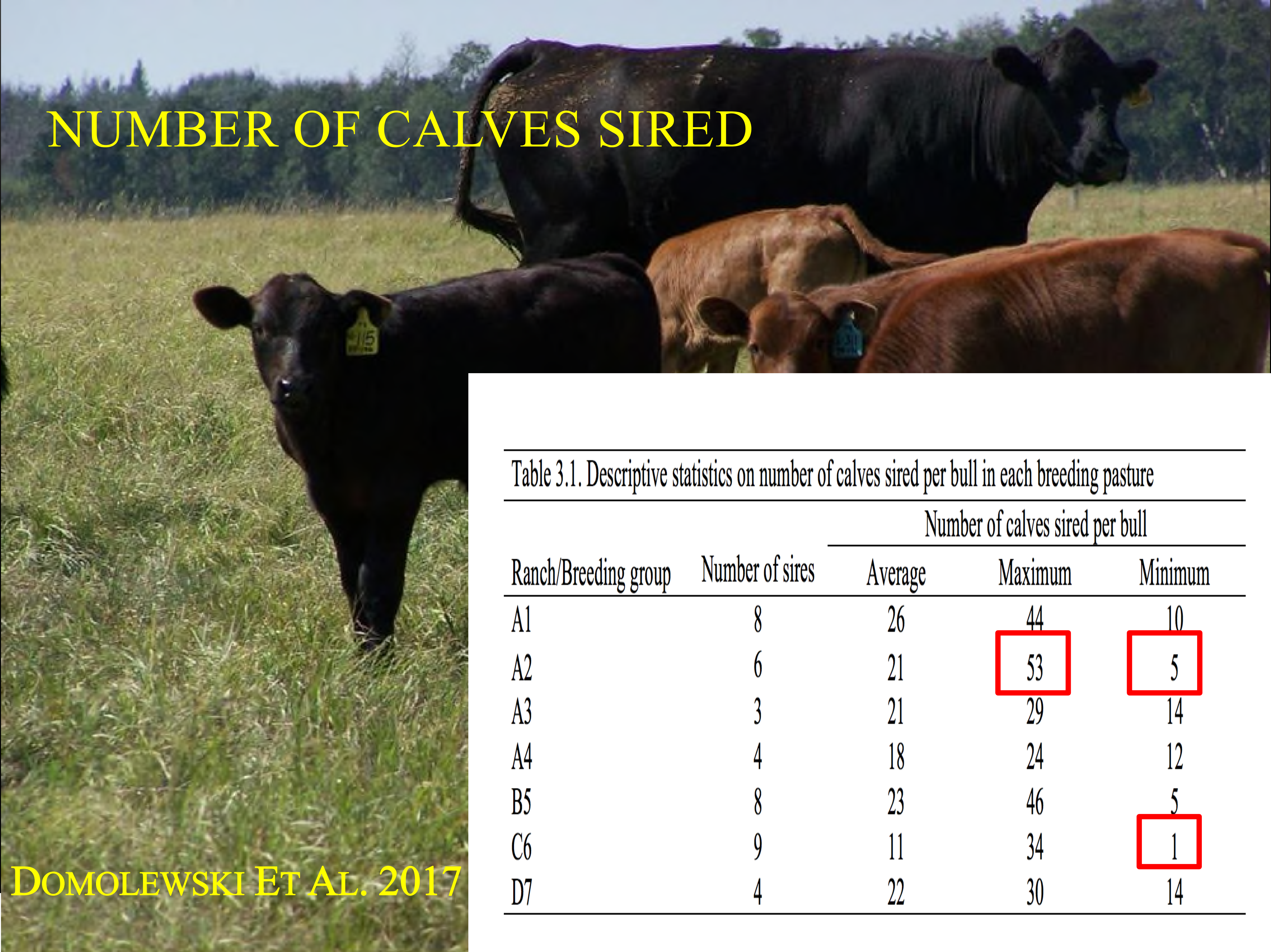


Table 3.1. Descriptive statistics on number of calves sired per bull in each breeding pasture

Ranch/Breeding group	Number of sires	Number of calves sired per bull		
		Average	Maximum	Minimum
A1	8	26	44	10
A2	6	21	53	5
A3	3	21	29	14
A4	4	18	24	12
B5	8	23	46	5
C6	9	11	34	1
D7	4	22	30	14

DOMOLEWSKI ET AL. 2017

What About Total Wean Weight Per Bull?

Table 3.6. Comparison of BPI for calves born on Ranch A

Breeding group	Sire	BPI total	Total lbs weaned
1	1108Y	0.5	6245
1	2151Z	1.15	15226
1	256A	1.27	17539
1	493Z	1.69	24742
1	51X	0.39	5341
2	13X	1.31	15027
2	144Y	0.94	9468
2	1496Y	0.47	4573
2	920W	2.48	29256
2	549Z	0.23	2395
2	198A	0.52	6070
3	122Y	1.32	14837
3	212Z	0.91	10184
3	228Z	0.64	7056

TESTING ONLY A PORTION OF THE HERD

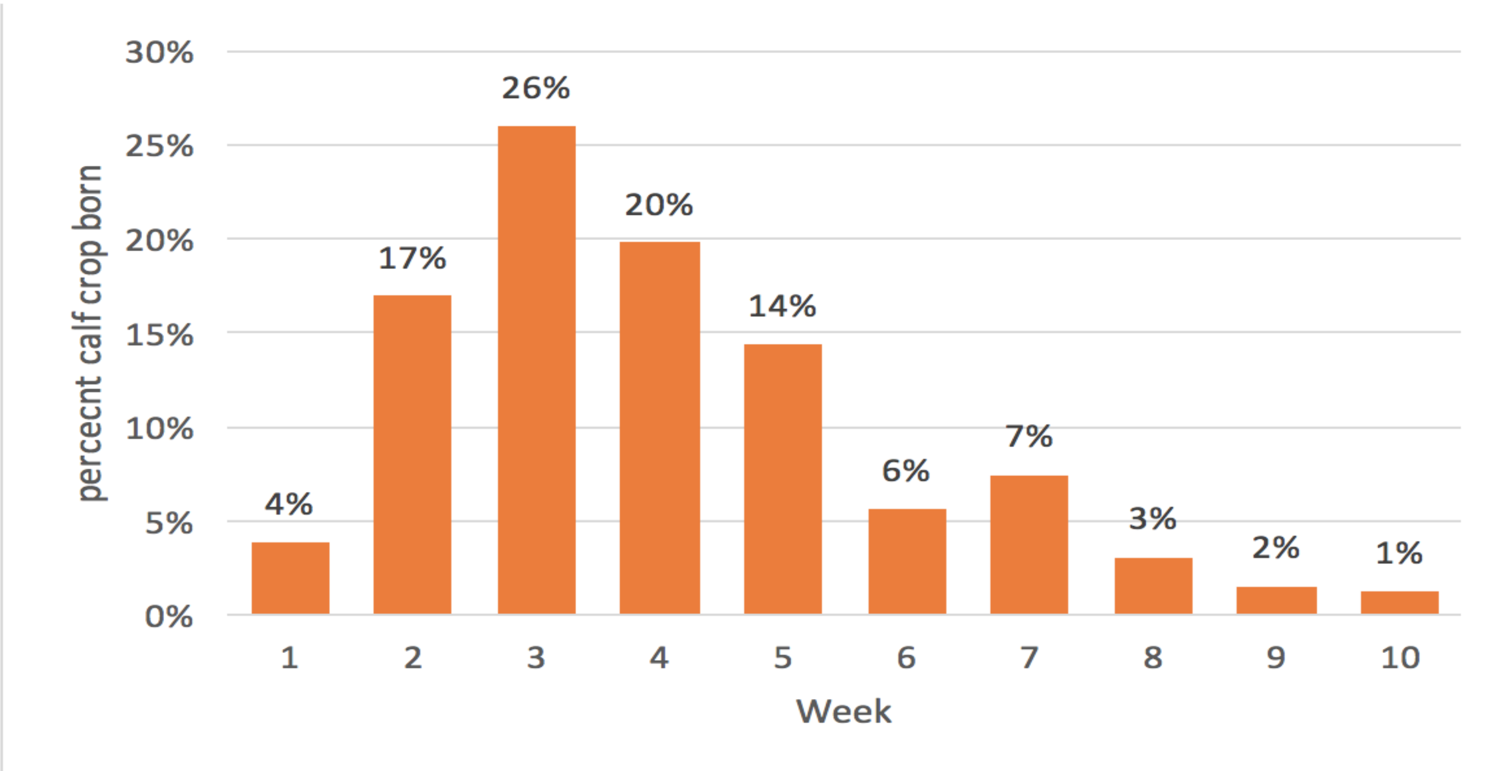


Figure 3.4 Percent of total 2015-born calves born each week at Ranch A

ELIMINATING DYSTOCIA

- Of all calves that die at or around calving, 51% … difficult birth (Bellows et al. 1987)
- Scenario:
  - 100 cows a…
  - 1…
  - 3 c… difficult birth
  - Test just calves from dystocia (13 x $12= $156)
  - Test all possible bulls (4 x $12 = 48)
  - Cost of lost calves (3 x 510 lbs x $1.80/lb = 2812.50)

Cost of test : $204.00

Cost of lost calves: $2812.50

CONSIDERATIONS

Applied Cow-Calf & Forage Research Program has evolved over the years…continues to evolve

Early on – only measured performance indicators

Now measuring environmental indicators – to validate producer activities