FROM FIELD TO BUNK:

GROWING AND FEEDING DAIRY QUALITY FORAGES

2018 Winter Workshop

January 8-12, 2018

SDSU Extension

Iowa State University Extension and Outreach

NDSU Extension Service

Nebraska Extension

University of Minnesota Extension

SDDP South Dakota Dairy Producers

isda Iowa State Dairy Association

Nebraska State Dairy Association

MDI Minnesota Dairy Initiative

Minnesota Milk Producers Association

AGENDA

9:30 am – Registration & Refreshments

10:00 am – **New forage genetic lines and how they impact the Dairy Industry** - Bruce Anderson, Professor of Agronomy, UNL Extension Forage Specialist

10:45 am – **Cover crops – Incorporating them into your forage production system** – Sara Berg, SDSU Extension Agronomy Field Specialist

11:30 am – Break

11:45 am – **Incorporating cover crops into dairy rations** – James C. Paulson, Associate Professor Forage Specialist and Nutritionist

12:30 pm – Lunch

1:30 pm – Sponsor recognition

2:00 pm –**Silage pile safety training for you & your employees** – Keith Bolsen, PhD, Professor Emeritus, Kansas State University, "The Silage Man", Nationally known speaker in silage production and safety practices.

2:45 pm – **Evaluating dairy diets from the nutritionist, to the employee, to the cow** – Authored by Fernando Diaz, DVM, PhD – Dairy Nutrition and Management Consultant – Rosecrans Dairy Consulting; Presented by Jim Salfer, University of Minnesota & Tracey Erickson, SDSU Extension Dairy Field Specialist

3:30 pm – Evaluation & Adjourn

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New Forage Genetic Lines Impacting the Dairy Industry

Bruce Anderson
University of Nebraska-Lincoln

Forage composition and cost has a major impact on dairy milk production and profits. Dairy producers cannot afford to use outdated forage types any more than they can afford to use outdated cow genetics.

All major forage types – corn silage, sorghum silage, cereal silage, and alfalfa – contain genetically controlled characteristics that influence their suitability as dairy forages. Listed below are some characteristics to consider for each of these forage types when selecting hybrids and varieties to significantly increase milk production.

CORN SILAGE

- % NDF (neutral detergent fiber). High concentrations of NDF reduce intake and lower energy due to the relatively low digestibility of NDF.
- NDF digestibility or digestible fiber. Higher NDF digestibility usually provides more energy and milk production potential.
- BMR (brown mid-rib). This genetic factor results in less lignin so fiber digestibility and intake increases. It also can increase lodging so include lodging resistance when selecting for this trait.
- Soft kernel. This recently released trait is demonstrating increased starch digestibility and higher feed efficiency resulting in more milk and more butterfat.
- Grain:forage ratio. High grain hybrids may produce more milk if both fiber digestibility and starch digestibility are high.

SORGHUM SILAGE

- %NDF and NDF digestibility. At least as important in sorghum as in corn since sorghum silage tends to have more fiber than corn silage.
- BMR-6. This BMR trait can enable sorghum silage to have energy value similar to corn. Lodging remains a concern, especially with tall varieties/hybrids.
- Brachytic dwarf. Genetic trait that shortens internodes, resulting in shorter and leafier plants that yield as much as taller types. When combined with the BMR trait, lodging problems usually are overcome.
- Cracked berry. Not a genetic trait *per se*. Sorghum grain has a hard seed coat that can cause grain to pass completely through the digestive system. Silage must be processed adequately or silage must be harvested prior to the hard dough stage to access and utilize the starch in the berry.

CEREAL SILAGE

- Smooth or reduced awns. Awns on certain cereals, especially barley, triticale, and wheat, can cause discomfort or even injury, resulting in reduced intake and performance. Varieties are available that lower this risk.
- Lodging resistance. To obtain high yields from cereals, high rates of nitrogen fertilizer often are used, which increases the risk of lodging. Select varieties with greater resistance to lodging under risky conditions.
- Maturity. Wheat and barley silage harvested at the flowering to early milk stage often has reduced palatability and digestibility. Highest protein and digestibility occurs at boot stage although yields are relatively low and moisture high. Maximum yield of dry matter and digestible dry matter usually occurs at mid-dough for all cereals.
- Barley. Among cereal species, barley usually has superior forage quality. Within barley varieties, however, semi-dwarfs tend to be better than 2-row types, which are better than 6-row types.

ALFALFA

- Reduced lignin. Varieties have been released recently that contain less lignin, both from using conventional and GMO breeding techniques. This enables alfalfa to be more digestible. These varieties can be harvested at conventional growth stages for higher quality forage or can be allowed to grow for a slightly longer time between cuttings for higher yields with the same forage quality.
- Higher digestibility. Like reduced lignin varieties but selected specifically for higher digestibility regardless of lignin concentration.
- PPO (red clover enzymes) alfalfa. Future varieties are expected to be available with this trait that is expected to reduce post-harvest protein degradation in alfalfa silage.
- Tannin-containing alfalfa. Future varieties that contain tannin may increase the amount of by-pass protein in alfalfa and also may reduce the bloat risk.
- Genetic traits that result in better leaf retention and in later flowering are being explored as new ways to increase alfalfa forage quality.

As new varieties become available that are expected to provide higher forage quality and, thus, increased milk production, it is critical that these differences can be measured accurately for proper forage selection and ration development.

For many of the forage quality improvements, traditional RFV (relative feed value) tests are inadequate, especially for improved digestibility. RFQ (relative forage quality) tests were developed to overcome many of these limitations. Even more advanced analyses, such as TTNDFd (total tract NDF digestibility) are becoming available to provide even better results.

Cover Crops- Incorporating Them into Your Forage Production System

Sara Berg, SDSU Extension
Agronomy Field Specialist

SDSU Extension

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Cover Crop History…

- 1948 Yearbook of Agriculture:
  - *"… farmers can grow as much, or more, corn, cotton, and small grains on smaller acreages when the cropping systems include grass and legumes."* –Uhland (USDA 1948)
- Less cover crop use mainly due to commercial fertilizers

Cover Crops

- Trending
  - Soil health/ground cover
    - Soil moisture/structure/biological activity/nutrient cycling/organic matter
  - Increased water infiltration
  - Reduces compaction
  - Reduced erosion
  - Weed suppression
  - Extended grazing season
  - Nutrient cycling
  - Microbiological activity
  - Additional feed options

Photo Credit: S. Berg

Cover Crops 101

Cool Season Broadleaf	
Alfalfa	Mustard
Alsike clover	Peas
Brassica hybrids	Radish
Canola	Rapeseed
Chickling vetch	Red Clover
Common vetch	Sugar beets
Crimson clover	Sweet clover
Flax	Turnips
Hairy vetch	White clover
Kale	Winter camelina
Lentils	

Cool Season Broadleaves

- Legume vs. Non-legume
  - sugar beet/flax
- Diversity:
  - Seed size
  - Salinity tolerance
  - Tolerance of poorly drained soils
  - Winter hardiness
- Work well when planted in fall following silage cutting/prior to warm season grass cash crops (corn)

Cool Season Broadleaf	
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Flax	Turnips
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Kale	Winter camelina
Lentils	

Cool Season Broadleaves: Brassicas

Positives	Drawbacks
Fall Growth	Don't tolerate poor drainage
High biomass production	High S and N uptake
Nutrient scavenging	Can choke out other species
Pest management	Sensitive to herbicide carryover
Break up compaction	Can be tough to kill
Winter hardy	
Quick decomposition	

Photo Credit: S. Berg

Cover Crops 101

Cool Season Grass
Annual ryegrass
Barley
Oat
Spring wheat
Tall wheatgrass
Triticale
Winter wheat
Cereal rye

Cool Season Grasses

- Readily accessible seed
- Many hardy options
- Generally nutrient scavengers
- Inexpensive in comparison to broadleaves
- Best planted prior to warm season broadleaves (soybeans)

Cool Season Grass
Annual ryegrass
Barley
Oat
Spring wheat
Tall wheatgrass
Triticale
Winter wheat
Cereal rye

Cover Crops 101

Warm Season Broadleaf	Warm Season Grass
Buckwheat	Corn
Cowpeas	Forg. sorghum/sudan hybrids
Dry beans	Grain sorghum
Safflowers	Millet
Soybeans	Sudangrass
Sunflowers	Teff grass
Sunn hemp	

Warm Season Broadleaves

- Legume vs. Non-legumes
  - Sunflower, Buckwheat, Safflower
- More fibrous roots
- Work well when planted in spring prior to warm season grass cash crops (corn)

Warm Season Broadleaf
Buckwheat
Cowpeas
Dry beans
Safflowers
Soybeans
Sunflowers
Sunn hemp

Warm Season Grasses

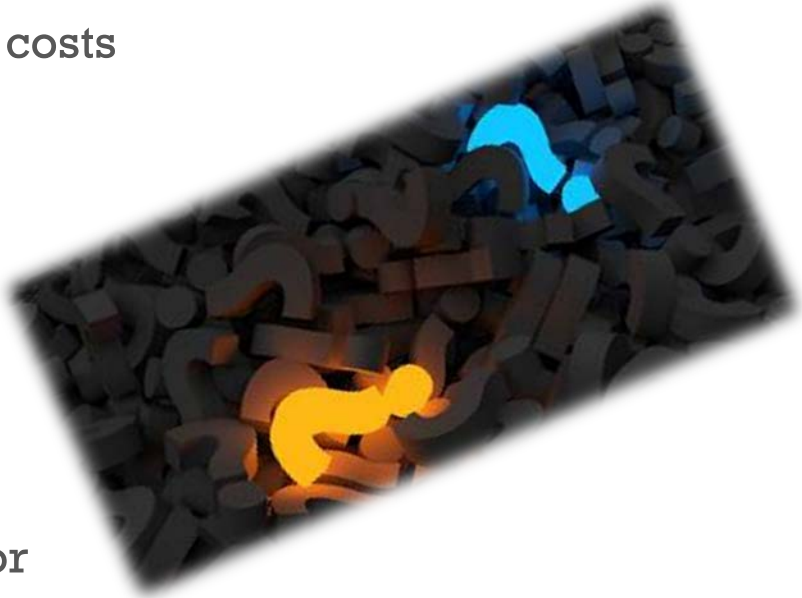
Warm Season Grass
Corn
Forg. sorghum/sudan hybrids
Grain sorghum
Millet
Sudangrass
Teff grass

- Generally tall crops/shade
  - Weed suppression
- Can be high in nutrition
- Prussic Acid concerns
  - Esp. Sorghum, sudangrass, sorghum/sudan hybrids, millet
  - Esp. after a freeze (rapid regrowth)
  - Maturity/climate/ fertility all factors

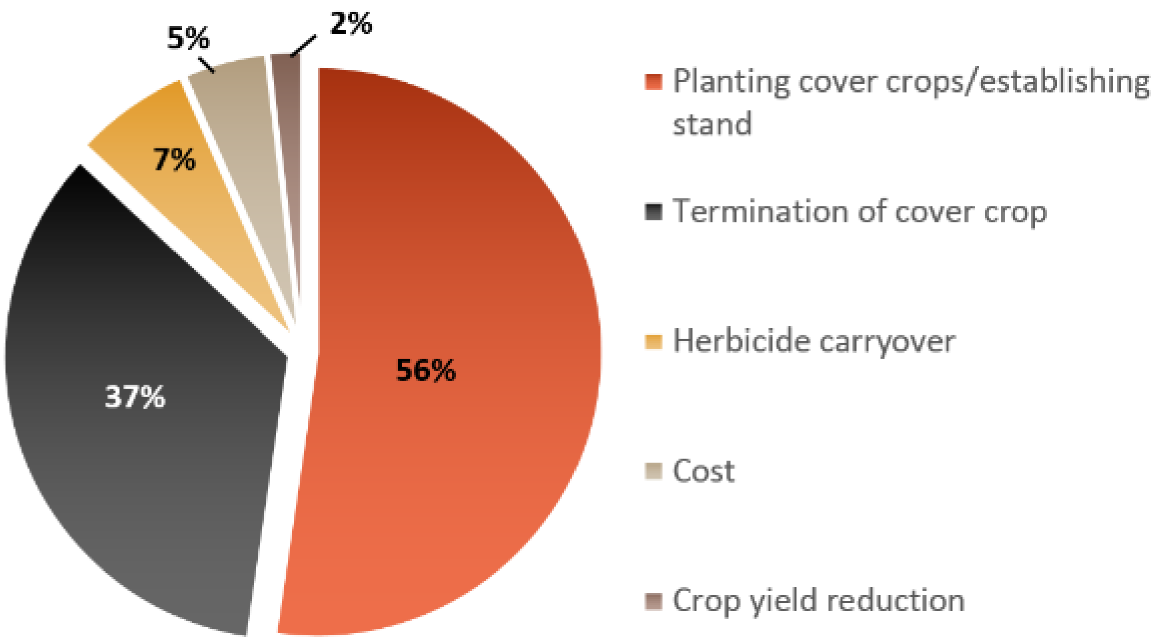
Photo Credit: S. Berg

Before You Begin…

- Identify objectives
- Time and place for planting
  - Opportunities for planting/seeding costs
  - Broadcast, drill, etc.
- Previous herbicides
- Soil and drainage situation
- Field traffic
- Winter kill
- Regrowth potential/termination
- Time to make it work; equipment/labor
- Crop insurance
- Plan B?



Challenges…



Challenges of incorporating cover crops, according to survey participants in a 2017 Nebraska Cover Crop Conference Survey.

- 82 respondents
  - 66 growers
  - 7 agronomists/consultants
  - 9 did not respond

L. Butts, 2017

Adding Diversity

- Cocktail mixtures are your friend
- Consider your current rotation (corn/corn?)
  - Corn silage offers a great CC window of opportunity
- Ideal to plant a cover crop 'opposite' to the cash crop to be planted following the cover

Making a Plan…

Soil Health Objective:

- Diversity
- Soil Cover
- Nutrient Cycling
- Living Root…

Feeding/Feed Sales Objective:

- Creative thinking is key
  - Green chopping
    - Oats and Field peas
    - Cereal rye
  - Baling
    - Cereal rye, winter wheat, winter triticale
  - Grazing
    - Many cool season broadleaves and grasses

Photo Credits: R. Beck

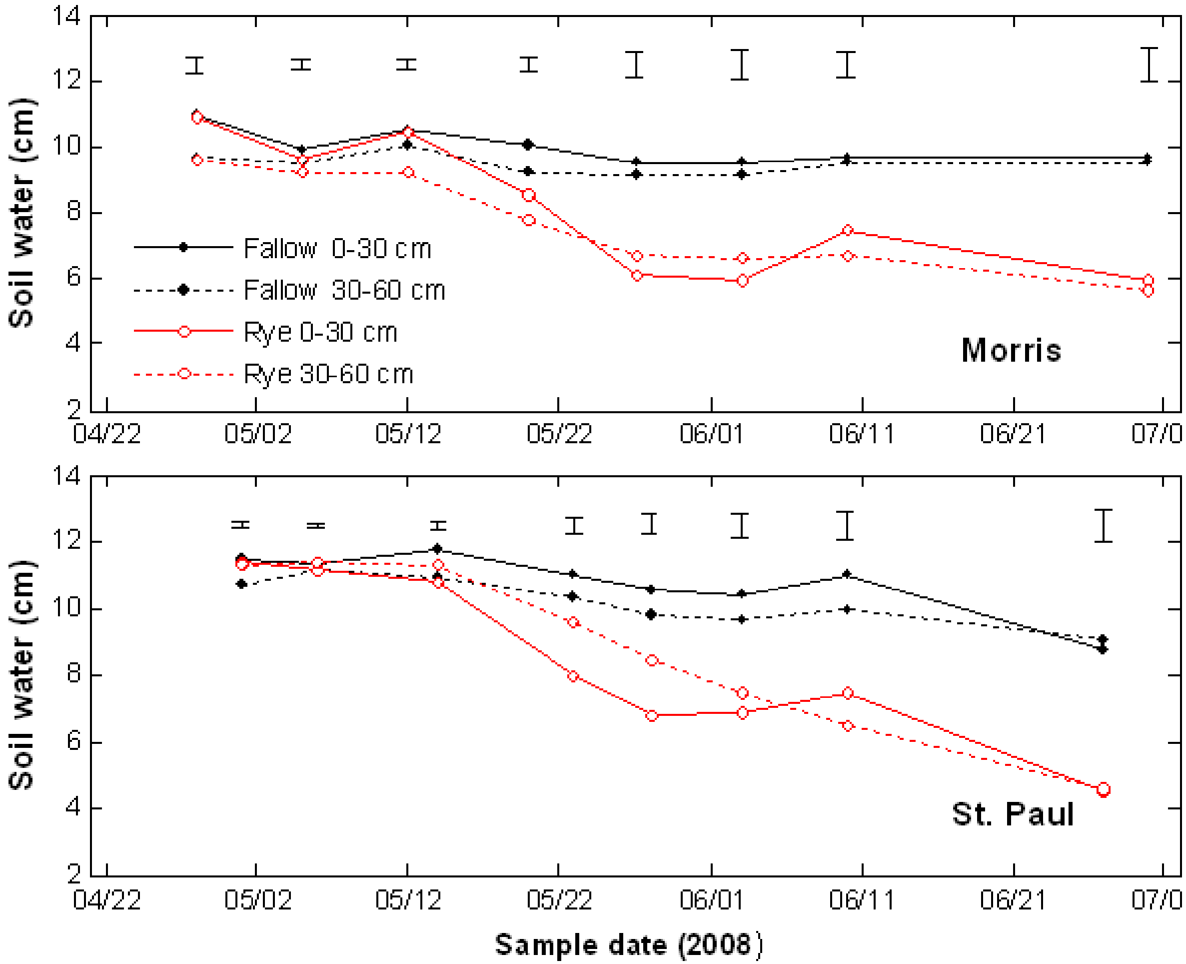
Cool Season Covers for Corn/Corn Silage Rotation

- Small grains: oat, spring wheat, spring triticale
- Winter grains: cereal rye, winter triticale, winter wheat
- Broadleaf Crops: canola, vetch, flax, pea, clovers, radish, turnip, etc.

Photo Credit: S. Berg

Soil Moisture

Soil moisture over time with and without a winter rye cover crop – by June 1, the difference was greater than 2.3" at both sites; data from a MN study. (Krueger et al., 2010)



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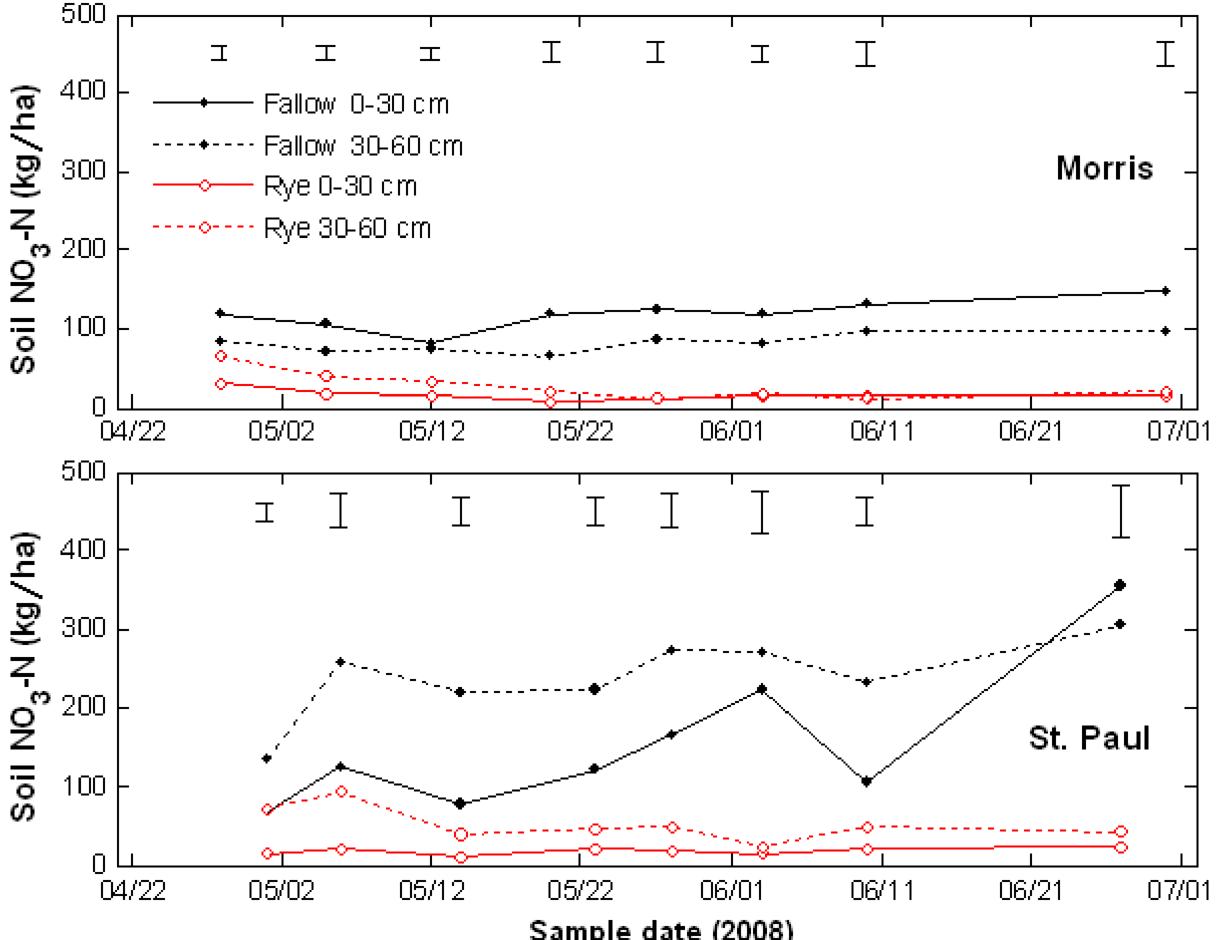
Soil Nitrate

Soil nitrate over time with and without a winter rye cover crop – by June 1, the difference was 150 lb or more of nitrate-N per acre; data from a MN study. (Krueger et al., 2010)



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Cover Crop- Effects on Corn Yield

Main Effects on Corn Yield: Cover Crop Blend, Grazing, N Fertilizer at Beresford, SD- 2016. (P. Sexton)

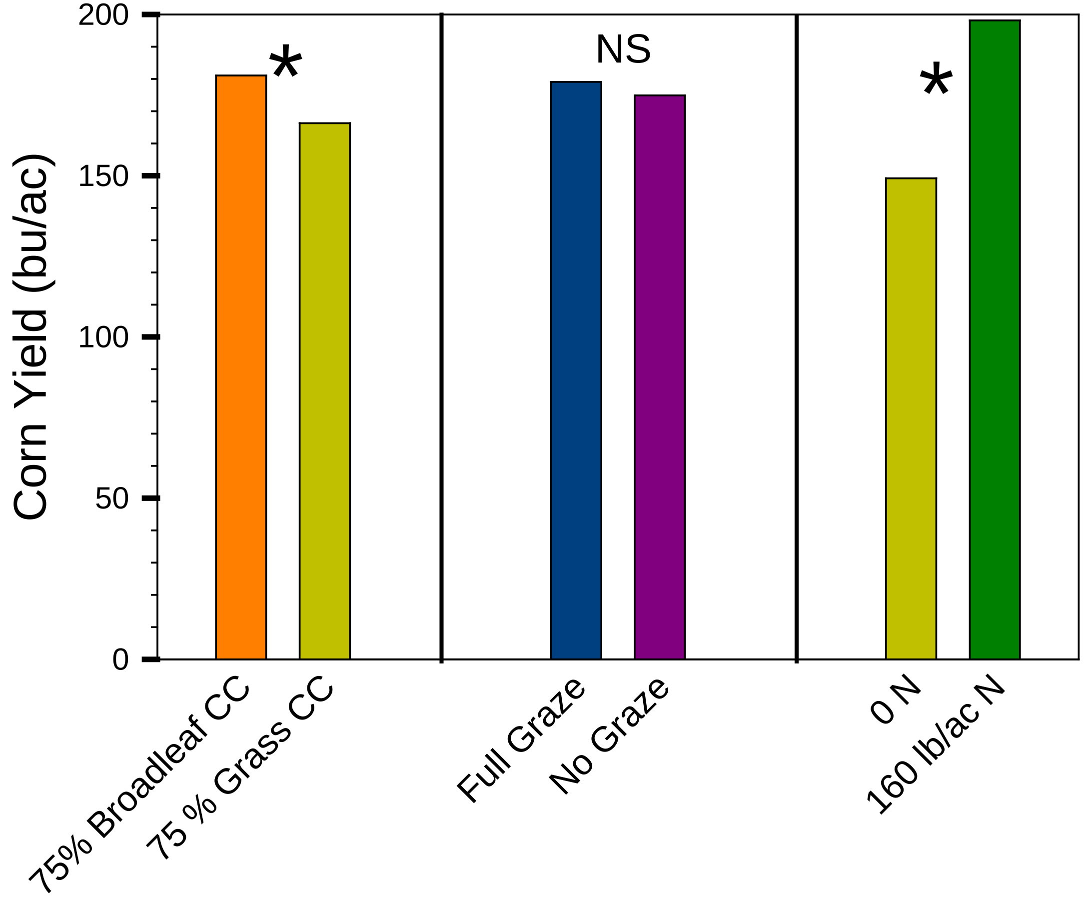



Photo Credit: P. Sexton

Silage Yield and N after Cover Crop

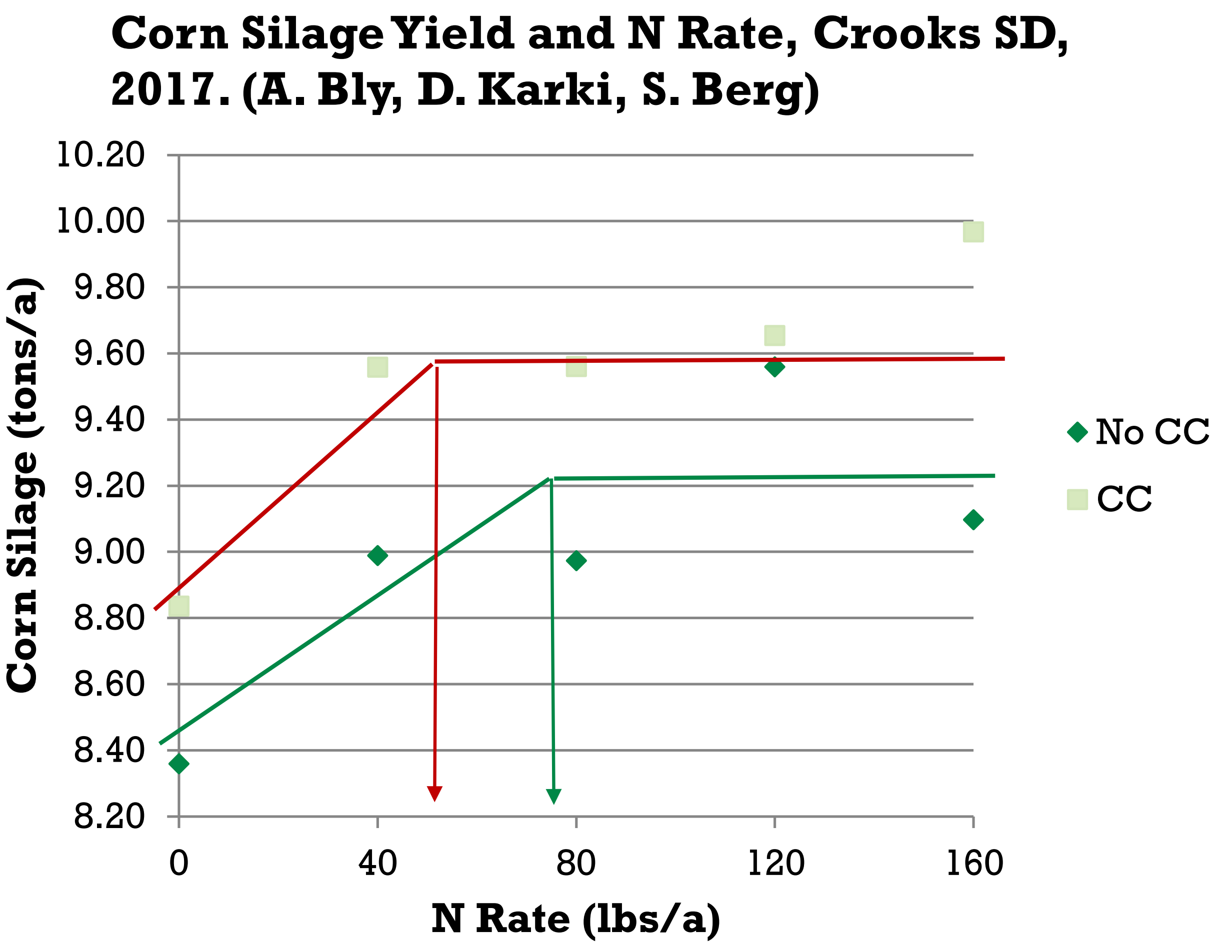
- Oats/Radish/Turnip cover crop mixture- 30 lbs/acre
  - Following corn silage
  - Sept 20, 2016
  - Objectives: reduce erosion, soil health
    - Annual mix- no burn down in spring

Soil Test Results from On-Farm Cover Crop Demo Following Corn Silage near Crooks, SD 2017. (A. Bly, D. Karki, S. Berg)

Treatment[1,2]	OM	NO_3-N
	%	lb/a
0 lb/a N, CC	2.5	20.0
0 lb/a N, No CC	2.4	13.6
160 lb/a N, CC	2.7	102.4
160 lb/a N, No CC	2.8	65.6

[1] Pounds per acre nitrogen fertilizer applied as urea
[2] CC=cover cropped with oat/radish/turnip blend at 30lb/a following corn silage. No CC=no cover crop planted.

Silage Yield and N after Cover Crop



Cover Crop Blend/ADG/N Study

Cover crop study with two blends on oat and rye stubble at Beresford, SD. (P. Sexton)

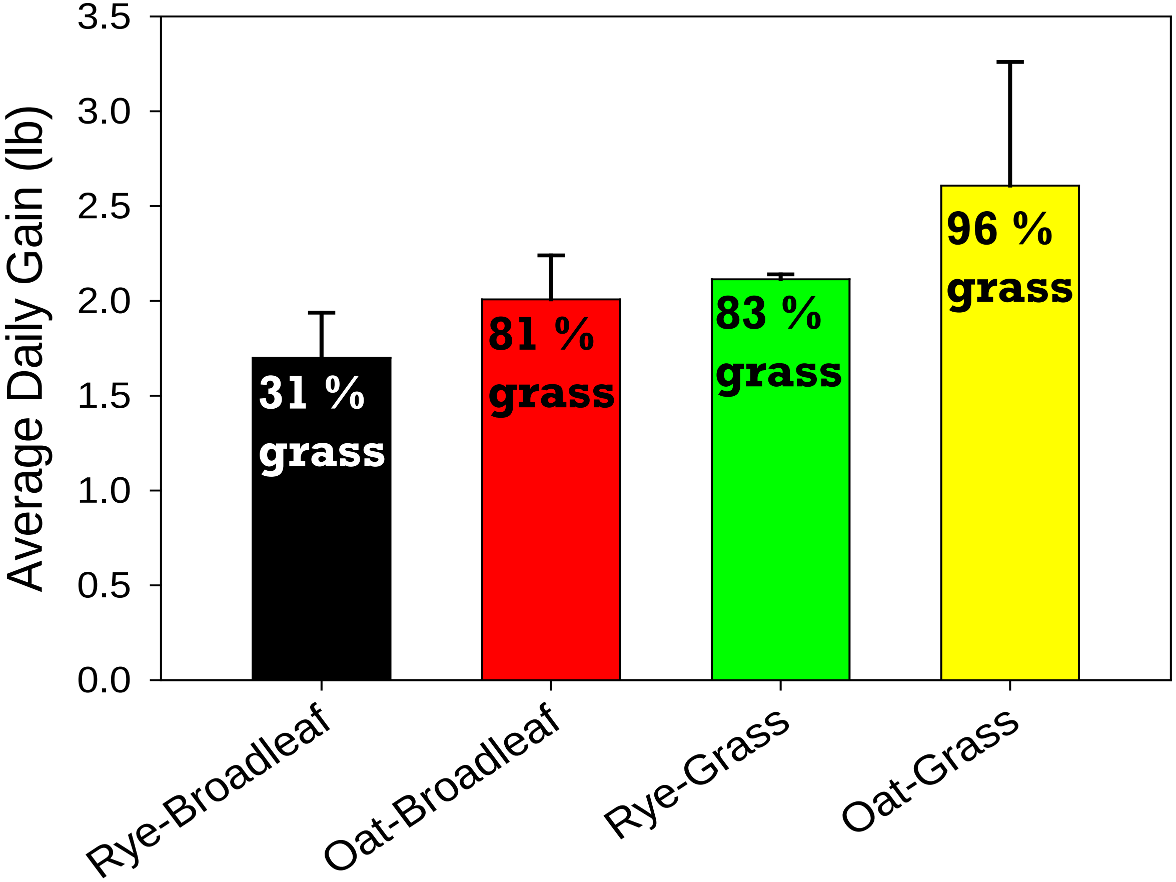
Cover Crop Blend	radish	pea	lentil	flax	sorghum-sudangrass	oat	cowpea	seed rate
	---------------------------------(lb/ac)---------------------------------							
Low Residue Blend: 75% Broadleaves	3.2	10.5	4.5	1	2.5	7	2.5	31.2
High Residue Blend: 75 % Grass Blend	0.8	3.5	1.5	1	5	35	2.5	49.3

Objectives: - compare cattle rate of gain

- compare effect on yield of next crop

Cover Crop Blend/ADG/N Study

Observed average daily gain of different cover crop blends in a study at Beresford, SD. (P. Sexton)



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Feeding Objectives Research

- Morris, MN, U of MN
- Feeding trial using dairy bull calves
  - Holsteins, HOL-Montbeliarde-Viking Red, and Normande-Jersey-Viking Red
- 15 paddocks; non grazed enclosure in each
- Winter wheat and winter rye planted 9/11/15 for grazing in 2016
- Yearlings grazed wheat and rye 4/25/16 – 6/14/16
  - Moved every 3 days
- Rye: 2,626 lbs. DM/A; Wheat: 2,021 lbs. DM/A
- Crude protein high in both crops- lowered beginning early May
- Digestibility of both crops very high

B. Heins, 2016

Feeding Objectives Research

Photo credit: J. Schweinhofer, Michigan State Univ.

- Holstein and MVH- NS difference in body weight
- NJV steers grazing wheat tended to be heavier than NJV steers grazing rye
- No significant ADG differences
- HOL and MVH gained more than NJV
- Steers on wheat (1065 lbs.); on rye (1010 lbs.)
- Dressing %, marbling, back fat, REA, YG not sig. different

B. Heins, 2016

Nutritional Value

- Laboratory Analysis
- Crude Protein
- When grazing- leaves before the stalk
  - Portable water and fencing
- Chopping for TMR
- NDSU resources for nutrient content of feeds
  - https://www.ag.ndsu.edu/publications/livestock/alternative-feeds-for-ruminants#section-0

But What about the Manure?

- Tricky but not impossible!
- Consider using dry manure when available
- Low disturbance injection options
- Timing of application
- Applying liquid manure to surface in standing cover crop
  - State Regulations

Cover Crops and Manure Research

- 2016-2017; 18 sites in MN
- Plant cereal rye after harvest
- Late fall- Inject liquid manure
- Terminate rye in spring
  - 24" soil NO_3-N and plant N in rye
- Harvest corn grain/silage in fall
- Measure yield and N uptake
- 2 cropping years

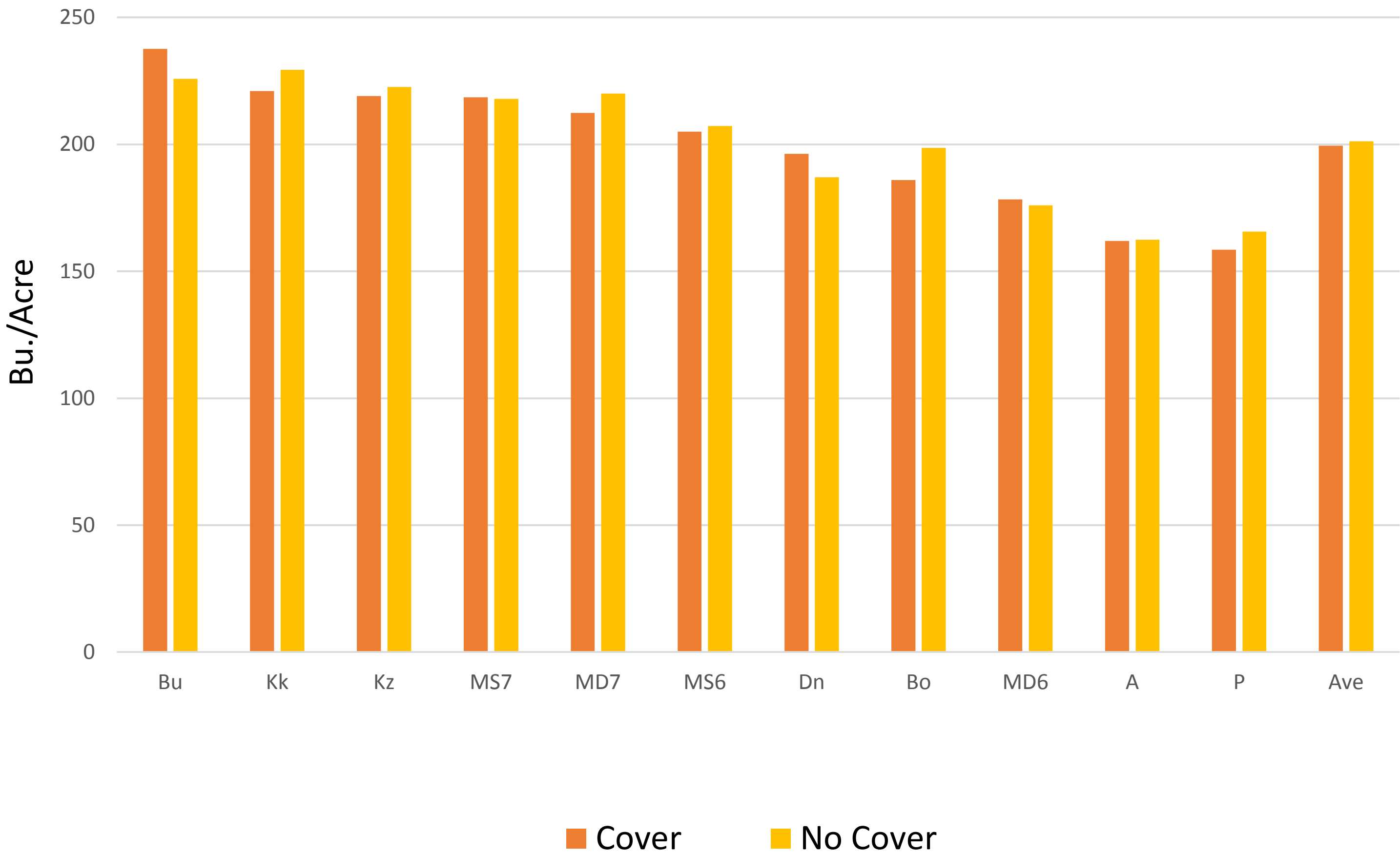
Photo Credit: Randy Pepin

R. Pepin, 2017


R. Pepin, 2017

Cover Crops and Manure Research

Corn Grain Yield (15%) in a Cover Crop Study with Manure. University of MN, 2016.



R. Pepin, 2017

Cover Crops and Manure Research

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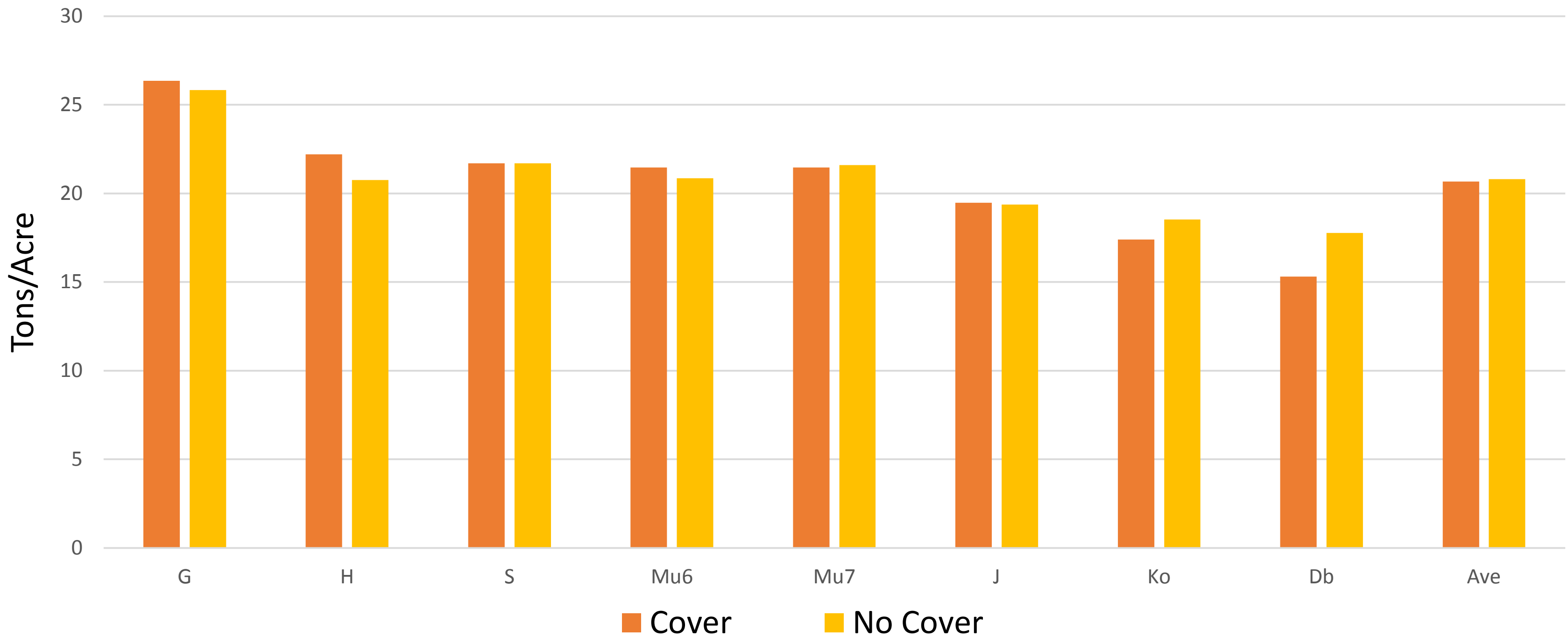
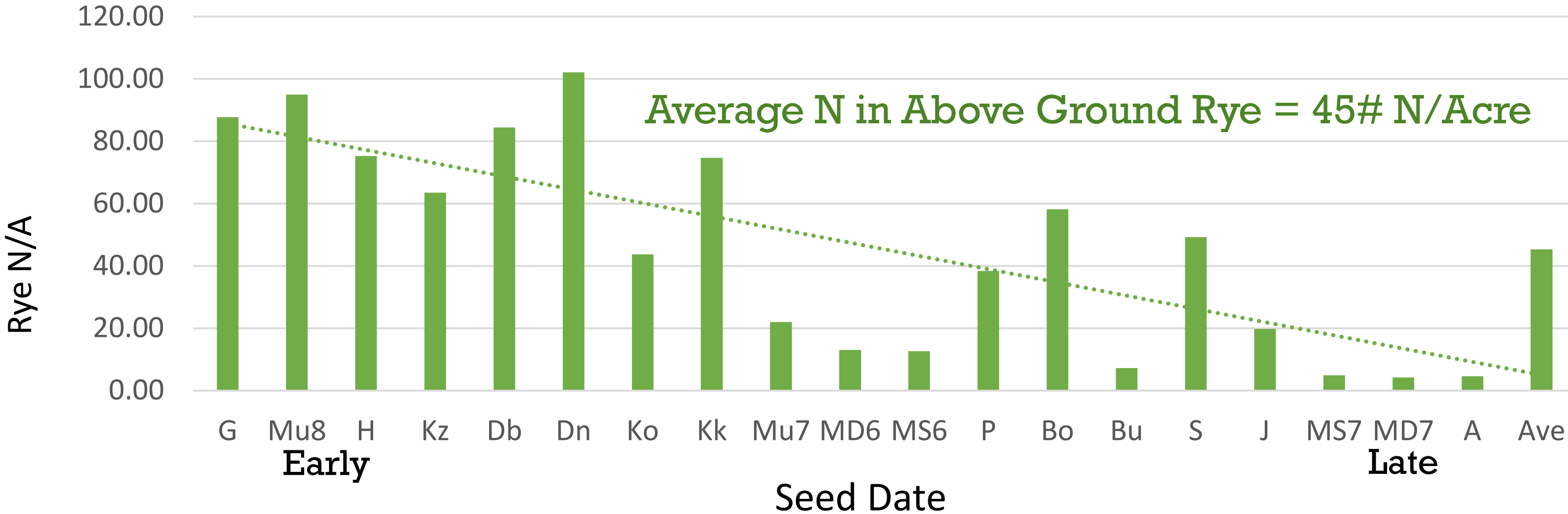
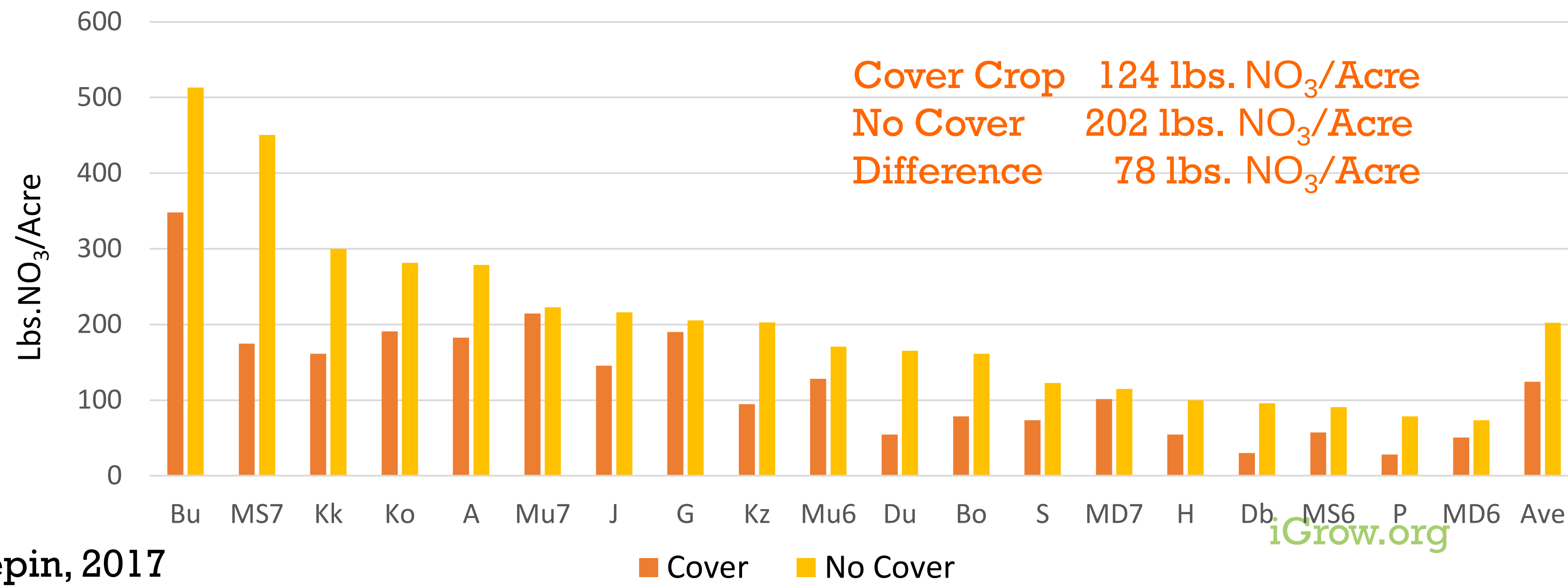


R. Pepin, 2017

Nitrogen in Rye at Termination in a Cover Crops and Manure Study. University of MN, 2016.



Spring Soil 24" Nitrate (NO_3-N) in a Cover Crops and Manure Study. University of MN, 2016.



R. Pepin, 2017

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Cover Crops and Manure Research

- Summary
  - Winter Cereal Rye can be successfully planted after corn silage or soybeans
  - Terminate Winter Cereal Rye at or before 8" for no significant yield loss
  - Winter Rye sequesters manure nitrogen
  - Other benefits to CC – Wind & Water
    Erosion Control, Soil OM, Soil Health

Seeding Rates and Blends

Photo Credit: Pulseusa.com

- Seeding rate varies depending on application method and objectives
  - Forages: higher seeding rates
  - Broadcast seeding will be greater than drilled
- Blends
  - Some pre-blended options from local businesses
    - Be sure mix matches NRCS enhancement requirements (if applicable)
    - Take % desired times normal seeding rate
    - Total % should add to 100

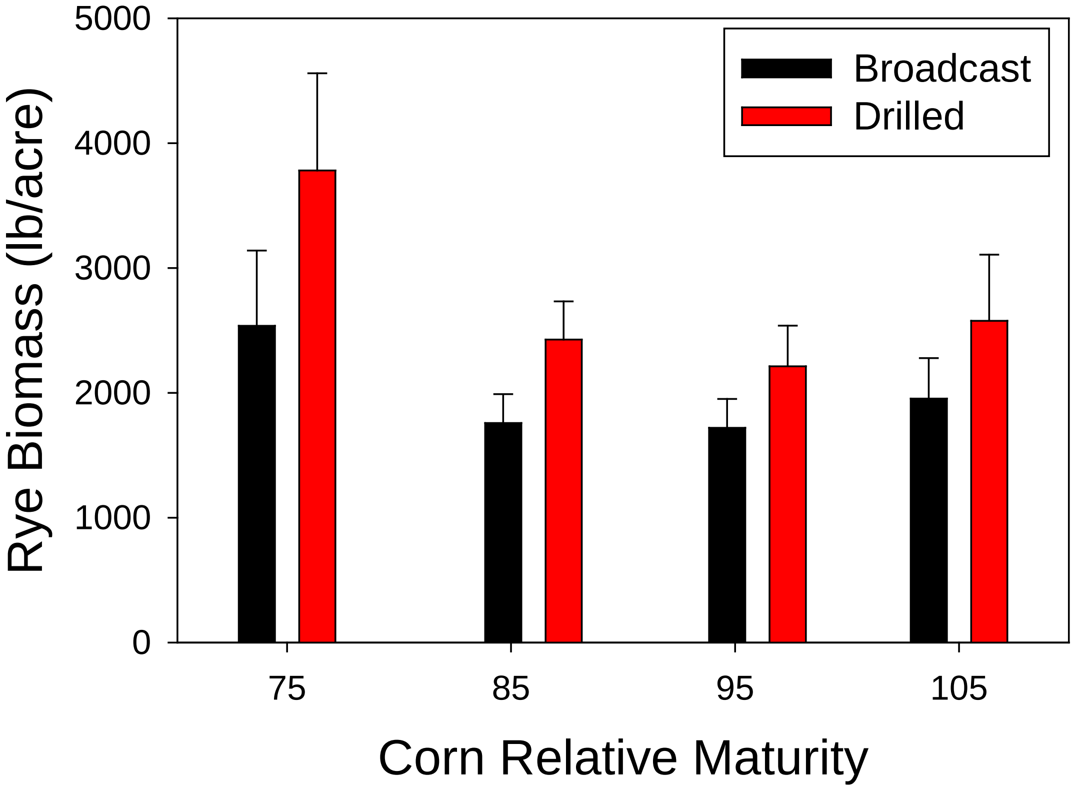
How to determine seeding rate:

Cool season seeded after oats, prior to soybeans, over winter, spring water management (30.75 % Brdlvs, 69.25% grass).			
Species	Full rate lbs/a	% of total	Seeding rate (lbs/a)
Radish	8	3	1
Turnip	4	3	1
Rapeseed	5	3	1
Crimson clover	15	6.25	2
Flax	25	15.5	5
Annual ryegrass	15	6.25	2
Barley	50	31.5	10
Winter wheat	60	31.5	10
Total (lbs/a)		100	32

A. Bly, 2016

Seeding Methods

Comparison of rye biomass production for broadcast seeding during late grain filling and direct seeding after harvest at Beresford, SD. Rye was harvested in the spring of 2014.



P. Sexton, 2014

$$$

- Seeding cost
  - Aerial seeding: $13-18/ac
  - Drilling: $14-16/ac
- Individual Seed Cost (Green Cover Seed)
  - Grasses $0.25-0.80/lb
  - Legumes $0.40-2/lb
  - Brassicas $1-4/lb
- Pre Blended (Millborn Seeds)
  - Balance Plus/Multipurpose 12lbs/a @ $1.5/lb
  - Classic Trio/Brassica blend 8lbs/a @ $2.00/lb
  - The Producer/late-season grazing and OM 20lbs/a @ $0.90/lb
  - Premium Graze/forage 15lbs/a @ $1.60

Practical Farmers of Iowa; Millborn Seeds Inc.

Dan Forgey's grazing blend

Species	Reason	Cost/lb	Full seed rate	CC rate	Cost
		$	Lbs/a	%	$/a
Buckwheat	MF	0.70	27	10	1.89
Flax	MF	0.18	27	10	0.49
Sunflower	MF	0.16	4	10	0.06
Oats	MF/C	0.07	65	15	0.65
BMR Sorghum	C	0.80	20	15	2.40
BMR Corn	C	0.45	22	15	1.49
Dwarf BMR Sorghum	C	1.15	23	14	3.70
Forage Peas	N	0.18	54	13	1.26
Lentils	N	0.24	30	10	0.72
Crimson Clover	N	1.00	16	6	0.96
Rape	B	1.00	5	10	0.50
Kale	B	2.75	8	10	1.76
Turnip	B	1.70	4	10	0.68
Okra	B	2.50	7	10	1.75
Inoculant		0.02		156	1.75
MF(mycorrhizal fungi), C(carbon), N(nitrogen), B(brassica)				Total	20.06

A. Bly, 2016

Resources for You!

- SD:http://bit.ly/SDCoverCrops
- MN:https://www.extension.umn.edu/agriculture/soils/cover-crops/
- ND:https://www.ag.ndsu.edu/plantsciences/research/forages/cover-crops
- IA:https://store.extension.iastate.edu/product/iowa-cover-crop-resource-guide
- NE:https://cropwatch.unl.edu/cover-crops
- SARE:https://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition/Text-Version/Cover-Crops/Types-of-Cover-Crops

Citations

- NRCS; https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/etpmctn12683.pdf
- Miller; https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_035768.pdf
- Hernandez; http://igrow.org/livestock/dairy/using-cover-crops-for-forage-supply-and-dairy-production/
- Heins; https://www.extension.umn.edu/agriculture/dairy/forages/forage-cover-crops/index.html
- Practical Farmers of Iowa; http://practicalfarmers.org/app/uploads/2015/07/Combining-CC-and-Livestock.pdf
- Lardy, Anderson, Dahlen; https://www.ag.ndsu.edu/publications/livestock/alternative-feeds-for-ruminants#section-0

Feeding Cover Crops

Utilizing the forage value of diverse crops used as cover crops

Jim Paulson

Fieldstone Consulting

Jim Paulson

Nutritionist and Forage Specialist

Fieldstone Consulting

Formerly, U of MN
Lots of colleagues help in the work

news NORTH DAKOTA STATE UNIVERSITY SEARCH
NDSU Extension Service
ND Agricultural Experiment Station
NDSU Agriculture Communication

Dust Storms Still Causing Damage in N.D.

The greatest export of phosphate is due to wind erosion.

Few people are aware that North Dakota has exported phosphate since the 1880s, according to Dave Franzen, North Dakota State University Extension Service soil science professor and soil specialist.

When settlers came to North Dakota, many wanted to farm but lacked the skills or tools to do so. Some migrated to the state from the East, where the soils and environment were very different. Those who came to North Dakota in the 1880s found an area that had few roads, no infrastructure, few neighbors and little source of income.

"Across the prairie were scattered millions of pounds of buffalo bones," Franzen says. "Some of these bones came from natural death, while many others came from the slaughter of buffalo during the earlier migration of hunters looking for hides to ship to the East."

The bones were gathered by the settlers and taken to railroad depots at Ellendale, Fort Totten and other locations.

"The bones were sold for cash of up to $15 per ton, which was big money in those days," Franzen says. "The settlers used the cash for food to survive or upgrade their sod houses. From about 1880 to 1892, when the trade all but ended, my estimate is that about 32 million pounds of bones were shipped east for fertilizer and industrial uses from North Dakota."

The nutrient content of bone is about 3-15-0, or about 15 percent phosphate (P). Using these figures, we can estimate that about two years of phosphate applications were shipped east at today's historic high rates.

"Today, the greatest export of P is due to wind erosion," Franzen says. "North Dakota is one of the windiest regions on Earth. Settlers used farming techniques from the old country or the eastern U.S., which did not consider wind erosion. So when the soil was dry, the soil blew."

Dust storms were very common in the 1920s, '30s and even today. The dust doesn't just settle in a nearby ditch. Accounts from the 1930s by aviators describe dust clouds to 14,000 feet in elevation, so dust can travel thousands of miles.

The P content of the dust that settled in East Coast states was 19 times that of what remained on the prairie, and the wind still blows today.

During the 1930s, North Dakota lost the equivalent of 40 years of P application at present rates.

Images

Buffalo bones being loaded into railroad cars in the 1880s near Krem, N.D. Photo from NDSU Germans from Russia Heritage Collection.

Soil dunes over a barn in Kidder County (1939). N.D. State Archives image.

Dust storm northern Red River Valley about 2005. Image courtesy of A.C. Cattanach,

Des Moines struggling with nitrate levels in drinking water

By DAVID PITT
Associated Press

"What we're seeing are numbers late into the fall and into the early winter like we've never seen before."
Bill Stowe, Des Moines Water Works CEO

DES MOINES, Iowa — Two rivers that supply water to 500,000 people in the Des Moines area show nitrate levels spiking to levels that make it unsafe for some to drink, a concentration experts haven't before seen in the fall that likely stems from especially wet weather in recent months.

The utility that supplies Des Moines and most of its suburbs had workers blending river water with other sources to lower the nitrate levels, but the situation may be nearing the point at which the city starts a process that costs about $7,000 a day to remove them. If that happens, the utility has threatened to sue the state.

On Friday, the nitrate level in the Des Moines River was at 12.8 parts per million and the Raccoon River was at 13.7. The U.S. Environmental Protection Agency requires officials to inform the public about safety risks at 10 parts per million.

Iowa and other states often have problems with nitrates in the spring, when rain washes unused fertilizer from farm fields. But it's unheard of to have spikes so high in November, said Des Moines Water Works CEO Bill Stowe. Scientists believe the current problem is caused by wet weather in the late summer and fall, which sent nitrogen remaining in the soil washing downstream.

"What we're seeing are numbers late into the fall and into the early winter like we've never seen before," Stowe said.

Stowe said so far workers were keeping the drinking water at just over 8 ppm. Water above 10 ppm can be deadly to children younger than 6 months because the chemical can reduce the amount of oxygen carried in their blood. Pregnant women and adults with reduced stomach acidity are advised not to drink water above the EPA limit.

In spring 2013, nitrate levels hit all-time highs on both rivers when a wet spring washed nitrogen from fields after a severe drought. Water Works mechanically cleaned the water at a cost of $900,000 until nitrate levels subsided more than two months later. If it happens again, Stowe said the utility likely will sue, alleging the state is violating the Clean Water Act by failing to reduce the nitrogen levels in rivers.

Monitors in rivers throughout the nation show no other sites with such high nitrate levels. But the issue is especially severe in parts of Iowa given the intense farming and tiling of land. More than 2 million acres in west-central Iowa drain into the Raccoon River, most of it cropland or livestock farms. An estimated 78 percent uses man-made drainage tiles to quickly move water downstream.

Although Iowa began a voluntary program in May 2013 that encourages farmers to make changes to reduce runoff, Stowe and environmental groups argue that strategy is toothless and lacks measurable benchmarks or a timeline for improvement.

For years, environmental groups have called for the state to regulate livestock farms, much as they already do for city wastewater treatment plans, which must have permits that limit release of contaminants into rivers. They're also seeking ways to measure and limit the release of nitrates from fields where tile has been laid underground.

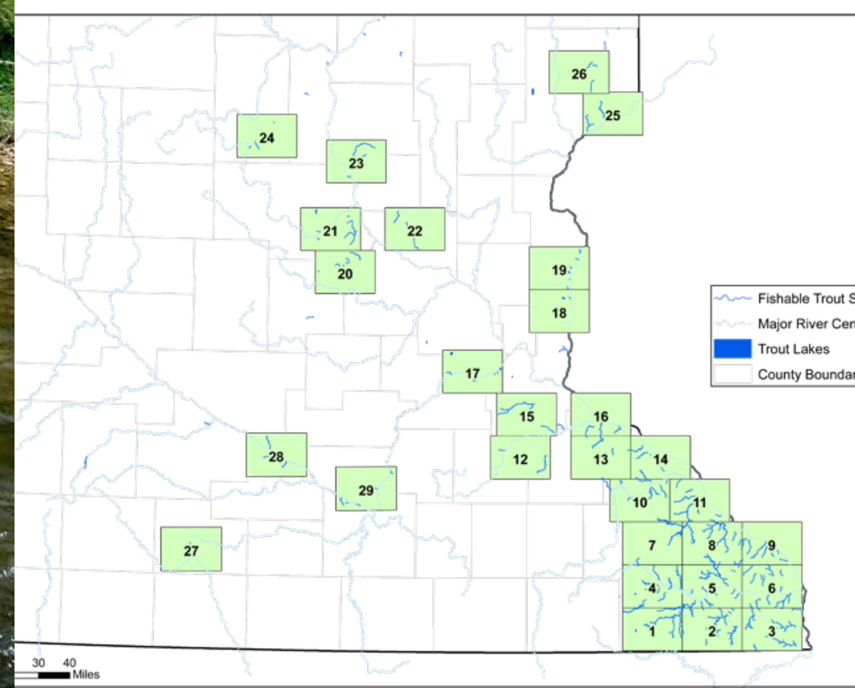
Iowa DNR spokesman Kevin Baskins said the state acknowledges the need to improve its waterways, but that it will take time for voluntary efforts to work. He said farmers are beginning conservation practices and government grants are giving them incentives.

"This isn't something where you just get instant results," Baskins said. "We didn't get into the kind of situation we have today in terms of excess nutrients overnight and we won't get out of it overnight."

Significantly reducing nitrogen levels likely requires slowing the flow of water into rivers by setting up wetlands or planting grasses or other cover crops on harvested fields, allowing the plants to retain water and consume excess chemicals.

"We have millions of acres on which we need to implement this stuff," said Chris Jones, an environmental scientist with the Iowa Soybean Association who has studied the Raccoon River.

Bismarck Tribune 11/23/14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Trout Lakes
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Miles

Cover Crops - Defined

- **A non-cash crop grown between two cash crops. ?**

Three/Two System

- **Three forage crops grown in two years**

3/2 system

John Deere-Van Brunt One-Horse Fertilizer Drill

Cover Crop Guidelines

- Diversity is a goal
  - Root depth, type
  - Plant type (grasses, legumes, annuals, broadleaves, pollinators

  Be specific for your farm and fields

  Time of year for growth

  How much diversity?

  3 or 5 or 10 or 20?

  Plant populations?

  Carbon : Nitrogen

Common Cover Crops

- Cool season
  - Grasses - ryegrass
  - Legumes- peas, clovers, vetches
  - Cereal grains- oats, triticale, rye
  - Brassicas- turnips, radishes
  - C3
- Warm Season
  - Sorghum and Sudan as well as crosses.
  - Annual grasses- millets, Teff,
  - C4

SARE Survey: Crops Used

Winter cereals – 73% (cereal rye, triticale)
Legumes - 54% (clovers)
Brassicas – 54% (turnips, kale)
Annual grasses – 53% (annual ryegrass, So/Su)
Multi-species – 33%
Two species – 26%
Annual broadleaf – 20%

Roots of Cover Crops

- Variation in root depth
- Keeping plants doing something in the soil –
- life, organisms – we are measuring

- Build organic matter and soil carbon through plant and root growth


10/18/2013

Roots of Cover Crops

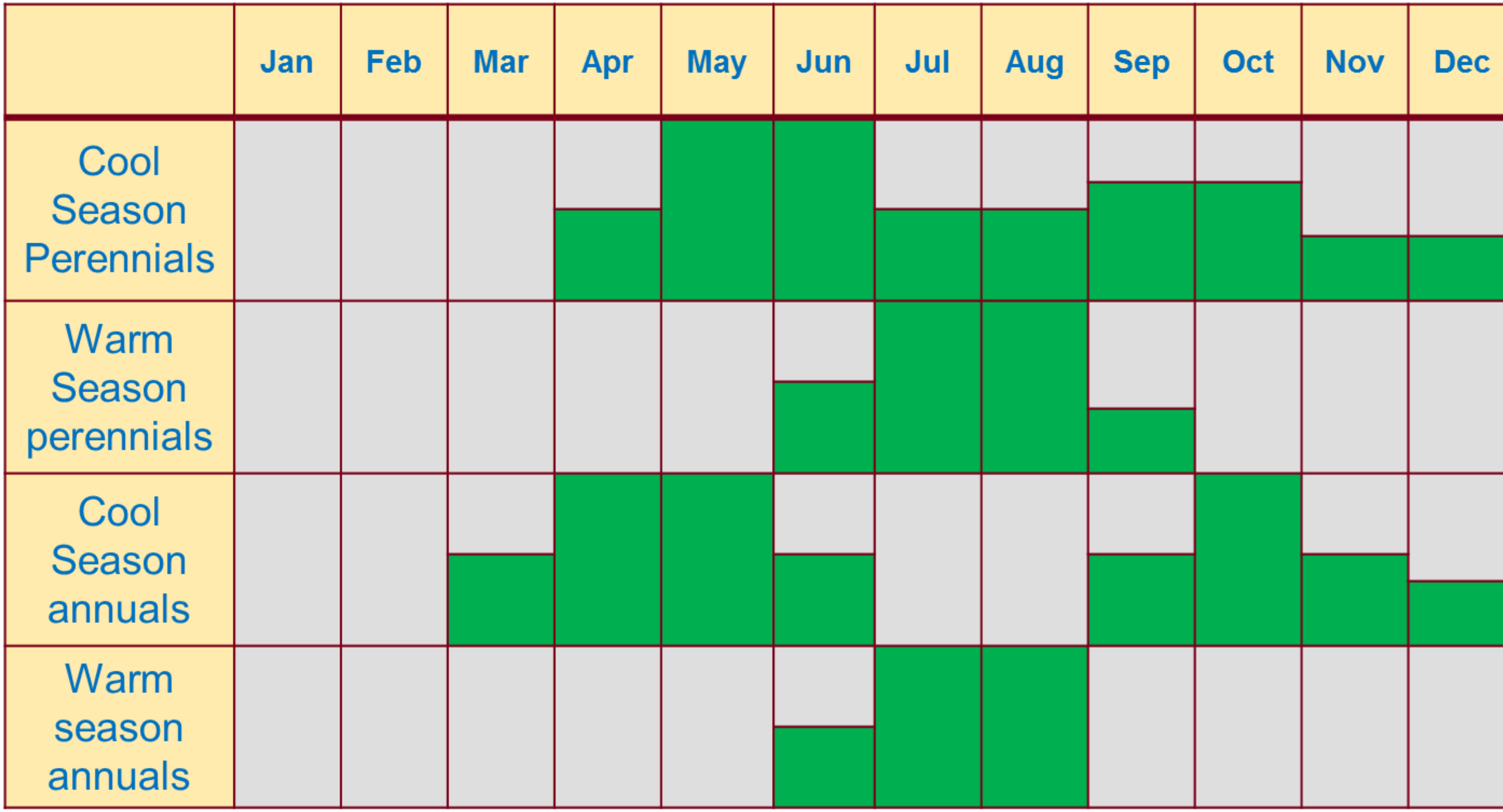
- Build organic matt
  and soil carbon
  through plant and
  root growth

Byron Seeds LLC
The Bridge to Better Forages

DAIRY GRAZING APPRENTICESHIP

MDI
Minnesota Dairy Initiative
SOUTHEAST REGION INC.

Building a Forage Chain



Every day we can graze is a day we don't have to feed!

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Stockpiling Forage

-**Any forage can be stockpiled, but quality of most declines sharply with duration of stockpiling time**

Some species retain quality better into the winter

-Tall fescue

-All brassicas, but especially rape and kale

> August 15- Fall Oats

- Planted August 15 + or -
- Grows Backwards in Decreasing Day Length
- Low Lignin Static NDF
- Can Have Very High Sugar Levels
- Late Cold Weather Silage Harvest
- Versatile with High TDN Potential

Older studies on small grain silage

Paulson et al. 1987

Comparison of alfalfa to either triticale or oats as the only forage in the diet.

Composition of forage			
Item	**Forage**		
	Alfalfa	Oat	Triticale
DM	43.5	28	37.8
NDF	43.8	54.8	52.4
ADF	32.9	32.1	31.1
CP	22.6	14	17.5

Older studies on small grain silage

Paulson et al. 1987

ets 50:50 Forage:Conc			
em	Forage		
	alfalfa	oat	Triticale
	16.4	17.2	17.3
F	33.7	41	40.4
	0.74	0.75	0.75

Milk Production			
Item	Forage		
	alfalfa	oat	Triticale
FCM	63	58	70
% Fat	3.7	3.7	3.9
% CP	3.4	3.4	3.4

Older studies using small grain silage fed to lactating cows

Fisher, L. J. , 1972. Using triticale silage

Marx, G.P., 1971. Feeding barley, oat or alfalfa silages to cows.

Marx and Youngquist. 1966. Comparing value of alfalfa haylage or oatlage for milking cows.

Recent Studies Using Small Grain Silage

- *Inclusion of wheat and triticale silage in the diet of lactating dairy cows*

- *M.T. Harper, J. Oh, F. Giallongo, G.W. Roth, A.N. Hristov*

- *Journal of Dairy Science*
- Volume 100, Issue 8, Pages 6151-6163 (August 2017)
- DOI: 10.3168/jds.2017-12553

- *Using brown midrib 6 dwarf forage sorghum silage and fall-grown*
- *oat silage in lactating dairy cow rations*

- M. T. Harper,* J. Oh,* F. Giallongo,* J. C. Lopes,* G. W. Roth,† and A. N. Hristov*1
- *Department of Animal Science, and
- †Department of Plant Science, The Pennsylvania State University, University Park 16802

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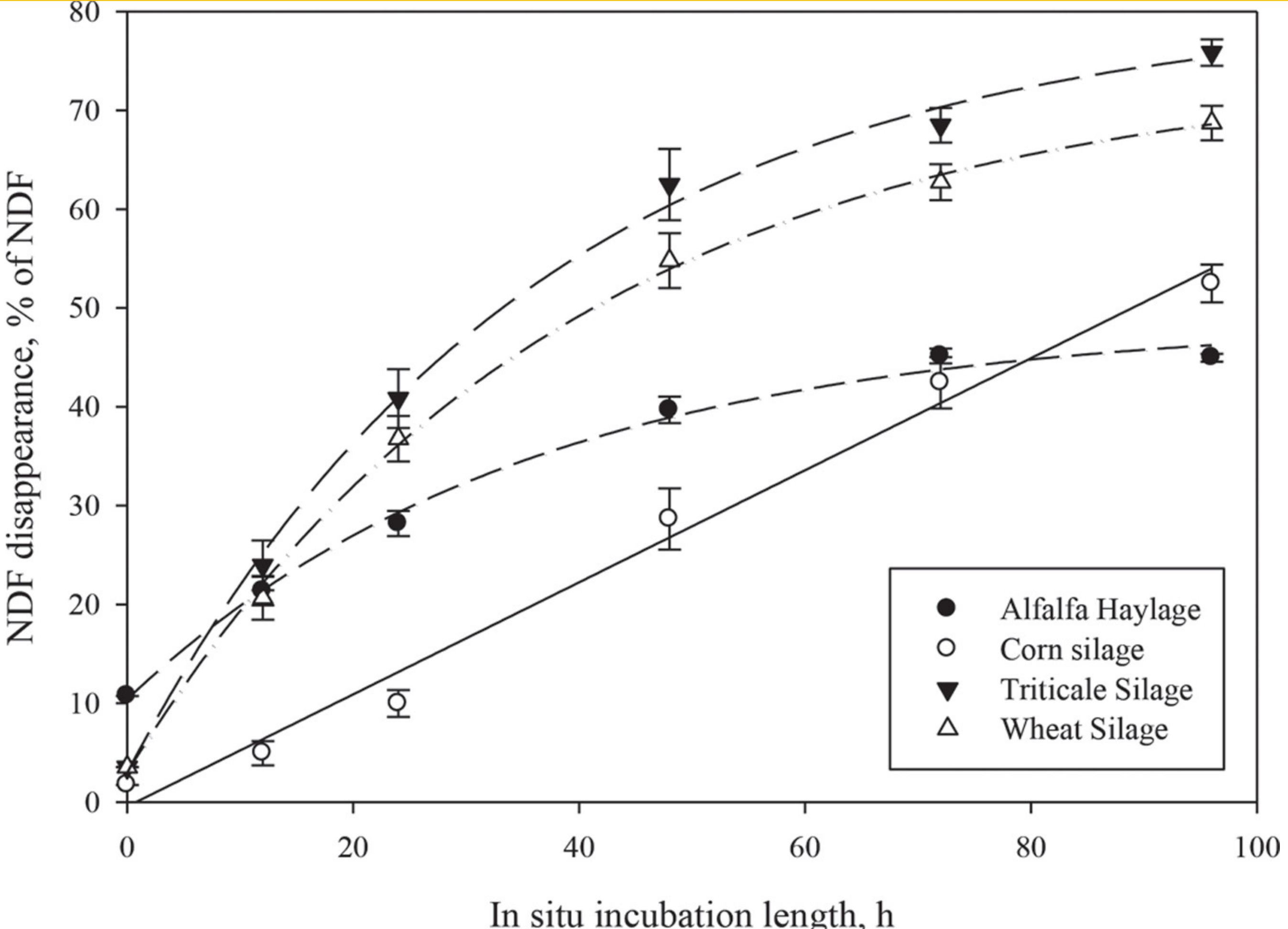
Harper et al.

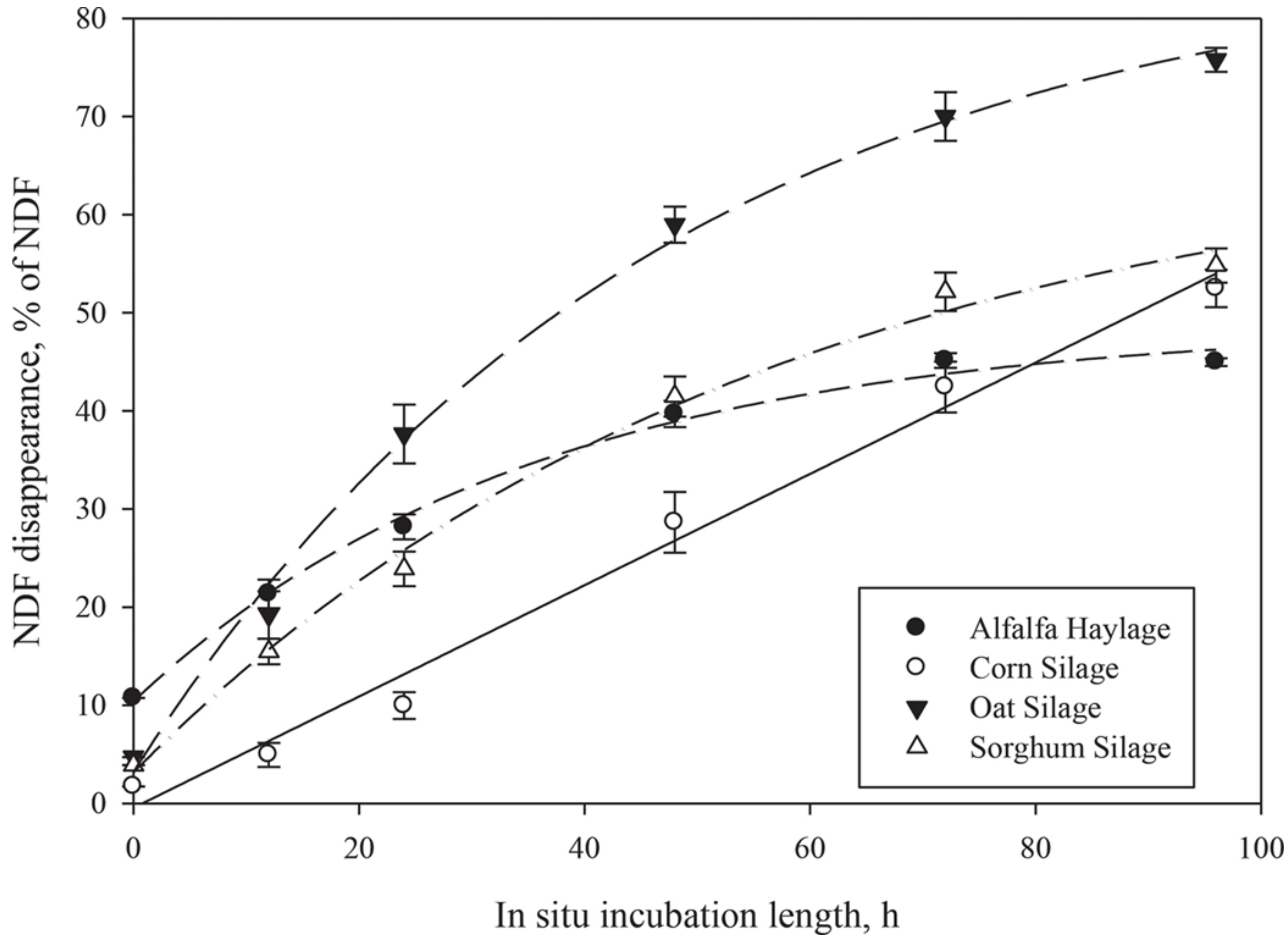
Composition of forage

Item	Forage						SEM	SEM	P-value<
	CS1	CS 2	Triticale	Wheat	Oat	Sorghum			
DM	39.1	38.5	30.7	40.7	31.6	31.4		1.42	<0.01
NDF	40.2c	41.0b	51.1a	51.0a	54.7b	62.7	0.96	2.25	<0.001
Lignin	3.70b	2.82c	3.47b	3.83a	2.86b	4.89a	0.103	0.319	<0.01
CP	6.83c	6.4c	17.3a	14.6b	11.7a	9.50b	0.32	0.199	<0.001
Starch	34.7a	34.5a	.3b	1.0b	.27b	.80b	0.96	0.863	<0.001

Rate and Extent of NDF Digestion of Forages



Rate and Extent of NDF Digestion



DAIRY GRAZING APPRENTICESHIP

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Triticale mature

Description (%DM unless specified)

Triticale Small grains forage

	DM Basis	60 day Avg.	4 yr Avg.
Crude Protein	9.48	13.84	13.40
Soluble Protein, %CP	75.46	53.44	
ADF	42.35	36.13	
aNDF	62.73	52.48	54.73

Triticale mature

Calculations

TTNDFD, %NDF	**43.97**	**47.76**	**44.30**
Dynamic NDF Kd %/hr	**5.10%/h**		

Milk 2006 Energy calculated using 30h Trad NDFD

TDN 1X	**44.72**
NEL 3x, Mcal/lb	**0.510**
NEG, Mcal/lb	**0.077**
NEM, Mcal/lb	**0.319**
Milk/Ton, lb	**1987**

Cover Crops Used for forage

		DM kg/acre	Ton/acre	CP	NDF	LIGNIN	T.D.N.
Kale		1239	1.36	23.21%	39.00%	4.54%	65.15%
Turnip		1600	1.76	17.23%	28.64%	2.36%	67.77%

Cover Crops Used for forage

		DM kg/acre	Ton/acre	CP	NDF	LIGNIN	T.D.N.
BMR sorgh		4045	4.45	14.34%	53.65%	2.84%	62.18%
sorg/sud		6580	7.23	10.90%	56.10%	3.32%	58.37%

Cover Crops Used for Forage

		DM kg/acre	Ton/acre	CP	NDF	LIGNIN	T.D.N.
Pearl Millet		3066	3.37	15.92%	54.83%	2.60%	60.60%
Forage Oats		1436	1.58	16.61%	50.99%	3.66%	62.23%

Summary

nk about when you are going to plant the cover crop cause that will affect your choices of forage.

nk about your options for harvesting the crop.

an choose your forage.

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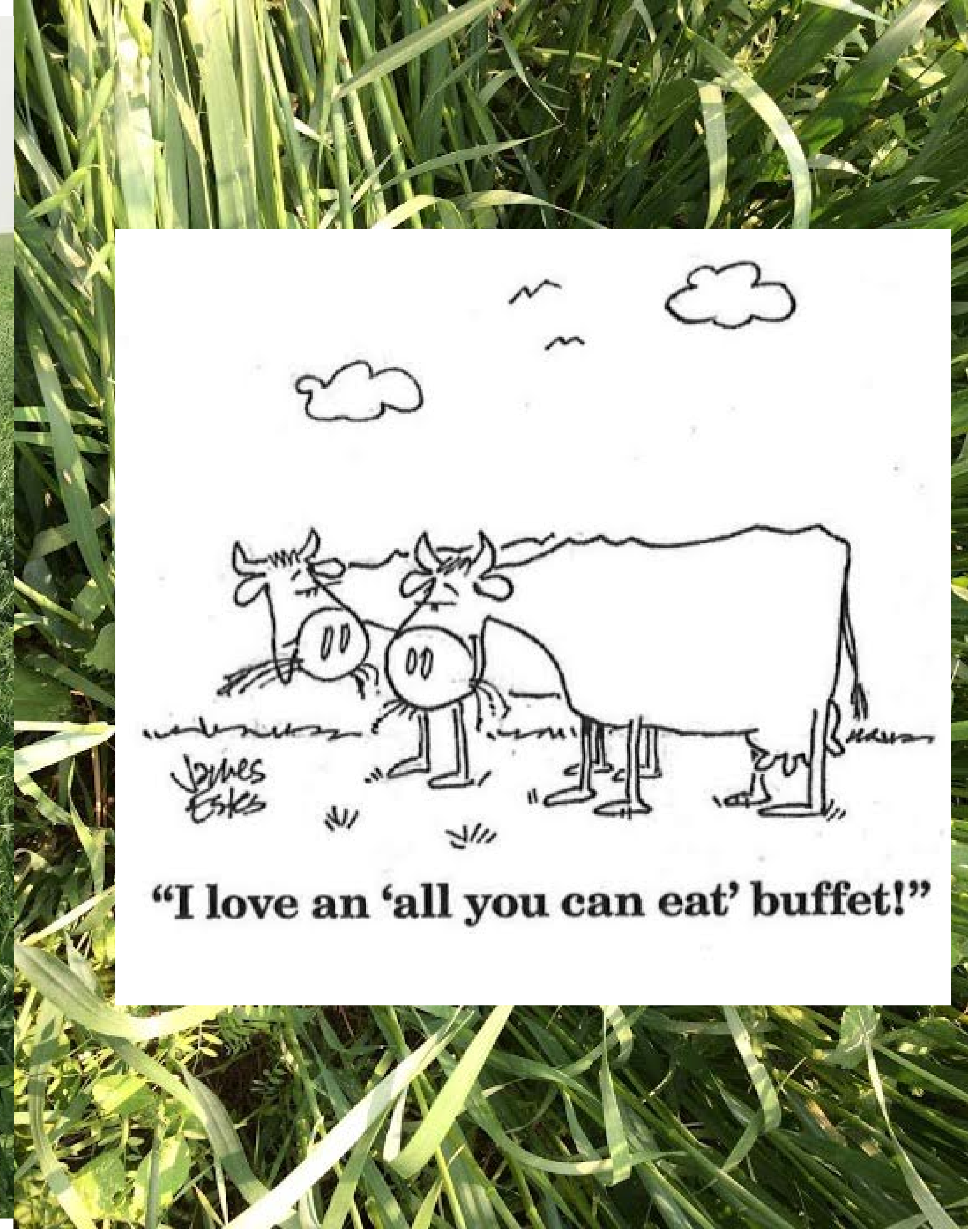
Thank You

Questions?

jcp@umn.edu



SILAGE SAFETY 101 – FOR BunkerS and PileS

I-29 Moo University Winter Workshop Series

January 8 to 12, 2018

Keith Bolsen[1] and Ruthie Bolsen[2]

[1] Professor Emeritus, Kansas State University
www.asi.k-state.edu/people/emeritus-faculty/bolsen/
[2] Director, Keith Bolsen Silage Safety Foundation

www.silagesafety.org

These ladies lost a son and brother to a preventable auto accident.

They lost a son and father to a preventable silage accident.

K·STATE
Research and Extension

Keith Bolsen
SILAGE SAFETY
FOUNDATION

PREFACE: Safety

***Safety is the control of recognized hazards to reach an acceptable level of risk*.**

•A hazard does not always affect the person who caused it - the hazard can affect anyone (USCHI, 2012).

Accidents are caused by unsafe behavior or conditions due to the actions of people:

•not cleaning mud off the ladder of a tractor or forage harvester

•forgetting to grab both sides of the handrail of a ladder

•moving a forage harvester without checking all sides and honking three time.

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SILAGE SAFETY
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PREFACE: Safety (cont.)

Every serious injury or fatality silage-related accident could have been prevented!

- **A split second of inattention can cause a fatal accident and nothing will ever be the same again.**
- **Keep in mind that we are not going to create a safety bubble for our employees or a silage program that is hazard-free, but following the guidelines in this handbook will significantly reduce the risk of someone being injured or killed on the farm.**
- **It is important to discuss safe silage management practices several times a year with your team because injury-related statistics suggest that many employees do not consistently follow the recommended safety guidelines.**

"Silage-related tragedies have no age boundary, as family members, employees, and bystanders of all ages have been injured or killed from harvest through feed-out."

"The first step in preventing a serious accident is to make sure everyone on your team is aware of the possible dangers."

Ruthie Bolsen

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Hereford Brand

(October 4, 2014)

Website accessed on September 9, 2017

"Last Friday, 21-year-old Alfonso Miranda was killed when the dump-bed truck he was driving tipped over in a silage pit at Great Plains Feedyard, Hereford, TX. According to Deaf Smith County Sheriff Dale Butler, the investigation concluded the death was an accident."

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Hereford Brand

(October 4, 2014)

Website accessed on September 9, 2017

(cont.) Sheriff Butler said circumstances of the accident are not uncommon. “Those trucks have been known to do that if not operated correctly”. Miranda was pronounced deceased at 7:11 pm.

He graduated from Hereford High School.

THINK SAFETY FIRST

"We have nothing to lose by practicing safety; but we have everything to lose by not practicing it."

Dennis Murphy, Extension Safety Specialist, The Pennsylvania State University, State College, PA

Major Hazards

- ✔ Fatigue
- ✔ Complacency
- ✔ Truck or tractor roll-over
- ✔ Run-over by machinery
- ✔ Entangled in machinery
- ✔ Fall from height
- ✔ Crushed by an avalanche
- ✔ Silo gas (NO_2)

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August 6, 2001

28 tons of silage avalanched on this dairy near Wendell, Idaho.

Believe me … It was scary!!

1. **No warning!**
2. **In a split second!**
3. **Silent!**
4. **Deadly for anyone beneath it!**

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Silage Avalanche Survivors –

Steve, Al, and Richard escaped without serious injuries.

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Richard Porter, farmer and rancher, Reading, KS – 1962

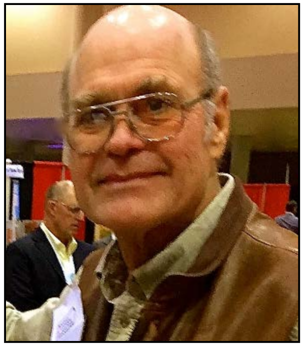
Al Kruse, beef cattle nutritionist, Sterling, KS – April 1983

Nick Schreiner, dairyman, Athens, WI - December 1999

Mac Rickels, dairy nutritionist, Comanche, TX - March 2000

Dr. Steve Soderlund, feedlot nutritionist, Parker, CO - July 2008

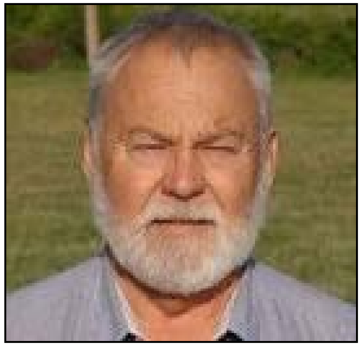
Rich



Al

Nick

Mac



Steve

Successful Farming (September 2000)

At 3:45 pm on December 3, 1999, about 6 tons of haylage in a bunker silo collapsed on Nick Schreiner of Athens, WI.

Schreiner was rescued in a matter of minutes, but he suffered a C6 spinal cord injury.

Nick is in a wheelchair.

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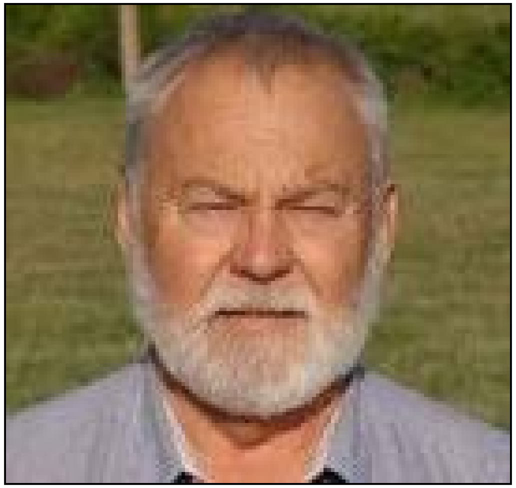
Dairy Herd Management (October 2000)

By Kim Schoonmaker



"Even though I was standing 20 feet from the face, 12 tons of silage collapsed on me. I didn't hear or see anything … "

"I had been in (silage) pits hundreds of times, and you just become kind of complacent because nothing ever happens … it just took that one time".

Mac Rickels; dairy nutritionist in Comanche, Texas.

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Personal communication from Dr. Steve Soderlund, who is a retired DuPont-Pioneer nutritionist in Parker, CO. **(July 2008)**

"I had a near miss earlier this year. I was taking a core sample at one of our large dairy customers, and I had just moved away from the face when a large section just fell off … This was a very well packed pile and had immaculate face management."

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Personal communication from Al Kruse.

Beef cattle nutritionist, Nutri-Tech, Sterling, KS.

(August 5, 2017)

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"In the spring of 1983, I was collecting a sample of high-moisture grain sorghum in a bunker silo at a feedyard in central Kansas. I had performed this task hundreds of times before. As a feedyard employee and I approached the feed-out face, it suddenly collapsed and buried me. Fortunately, the falling grain did not hit the employee. The heel of my boot was exposed, and I was pulled from the silage. I regained consciousness in the ambulance and spent 24 hours in the hospital for observation."

Personal communication from Al Kruse.

Beef cattle nutritionist, Nutri-Tech, Sterling, KS.

(August 5, 2017)

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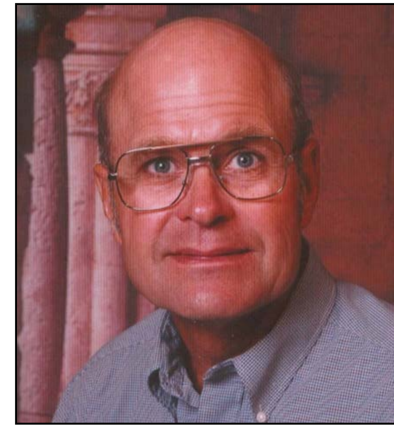
"(cont.) After my near-miss experience, I started taking samples from a payloader bucket after it was moved to a safe distance from the face. If no one is available to operate the loader, I simply do not pull a sample!"

"The 'buddy rule' probably saved my life that afternoon."

Personal communication from Rich Porter.

Farmer and rancher, Reading, KS.

(February 16, 2017)



I was buried in a trench silo in 1962 when I was 12 years old. One of our employees (Jim Hannigan) was using an Ensiloader to load the feed wagon. He was on one side and I was on the other side to scoop up the silage that fell to the outside of the loading box. Jim had gone to advance the tractor and Ensiloader into the silage when the cave-in occurred. He was not covered. I was next to the face of the silage, and completely buried with about 2 feet of silage. Jim dug me out in less than a minute. If he had not gone to move the tractor forward … we would have both been killed.

Personal communication from Rich Porter.

Farmer and rancher, Reading, KS.

(February 16, 2017)

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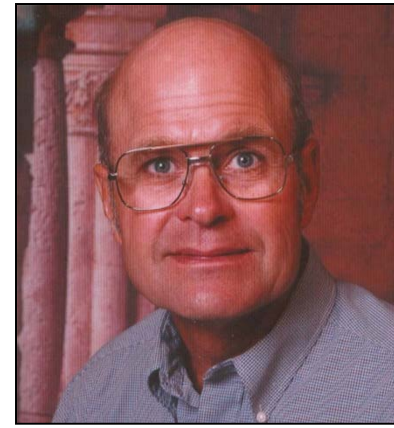

(cont.) When I was buried, I immediately knew what had happened. In this “near death” experience, I never saw a light, angels, or my life pass before me, as is sometimes reported in near death experiences. I felt no pain and was in total peace, knowing I would soon be dead. Then in the few seconds between when the rescuer first touched me and when he pulled me out, there was a huge pain in my lungs wanting to breathe, and pain from one of my legs being doubled behind. Other than literally having the crap knocked out of me, I suffered no injury.

Silage Avalanche Fatalities –

In the USA.

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Kenneth Hettinger, 63, Schrack Farms, Regersberg PA – February 2009

Andrew Wheeler, 11, MacGlaflin Farm, Claremont, NH – April 2010

Matt Winkelbauer, 53, Four-Quarters Feedlot, Norfolk, NE – October 2013

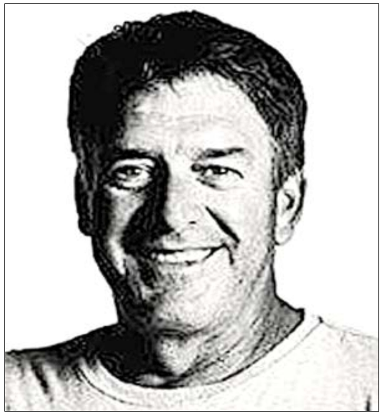
Jason Leadingham, 34, Pirtle Farms, Roswell, NM – January 2014

Donald Merchant, 54, Square A Farm, Lebanon, CT – March 2015

Victor Cante Reynoso, 30, Twin View Farm, Platteville, CO – August 2017

Kenneth

Matt



Jason

Victor

Man dies after being trapped in collapsed silage pile south of Johnstown - The Tribune. Greeley, CO (July 14, 2017)

On Friday morning, Victor Cante Reynoso was working on top of a corn silage pile at Twin View Farm, about 6 miles northwest of Platteville. He was removing the tarp and tires that covered the pile, according to the Weld County Sheriff's Office. He climbed down and went to pick up the tires when the silage pile collapsed on top of him.

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Man dies after being trapped in collapsed silage pile south of Johnstown - The Tribune. Greeley, CO (July 14, 2017)

(cont.) Sheriff's deputies responded to the emergency call about 9:00 am, and they found Reynoso unconscious. Emergency responders got his heart beating, but he died later that morning. He is leaving behind a loving and caring family … his wife Irene and son Victor.

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WMUR TV in Claremont, New Hampshire. Web site accessed on August 21, 2010.

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Chaves County Sheriff's Office – Man's death an accident - *Plains-Valley Online News* (January 14, 2014)

At approximately 12:20 p.m. on January 13, 2014, Jason Edward Leadingham was in a bunker silo of corn silage near Dexter, NM when about 15 tons of silage avalanched on him. The bunker silo was owned by Pirtle Farms. Jason's body was not recovered from the massive avalanche until 3 hours later.

It was determined that he died of mechanical asphyxia. There was a sample bag near Jason's left hip.

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Date: January 6, 2017 at 2:19 PM CST
To: 'Ruth Bolsen' <ruthbolsen@me.com>
From: Lane Leadingham

Thank you, God! Next Friday, January 13th, will be 3 years since Jason's tragic accident. I remember the phone call like it was yesterday. I suppose I really am "better", but it still crushes my heart and hurts me down to my core … I still try to make sense of his death and so far, the video is the only positive thing that came out of all of it.

I can never tell you "thank you" enough, and I know you share the pains of my heart Ruthie. We loved our boys so much ... *We miss our boys more than words can express*.

Hugs to you and Keith!
Lane Leadingham
Ruidoso, NM

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Child dies after being buried by silage (cont.)

A 9-year-old boy died on Sunday July 17, 2016, after silage caved in on him in the rural area of Elói Mendes in the state of Minas Gerais, Brazil. Daniel da Silva Andrade was playing in a bunker silo with his 5-year old cousin when the accident happened.

Keith Bolsen SILAGE SAFETY FOUNDATION

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Child dies after being buried by silage (cont.)

(cont.) The parents said the boy was in the silo with a wheelbarrow, when the feed fell on him and his cousin. Daniel died on the way to the hospital. ***He suffered a fractured cervical spine.*** The cousin, a girl, was also hit by the silage but kept her head uncovered. She was hospitalized overnight. (Cited by *Sul de Minas*, July 18, 2016)

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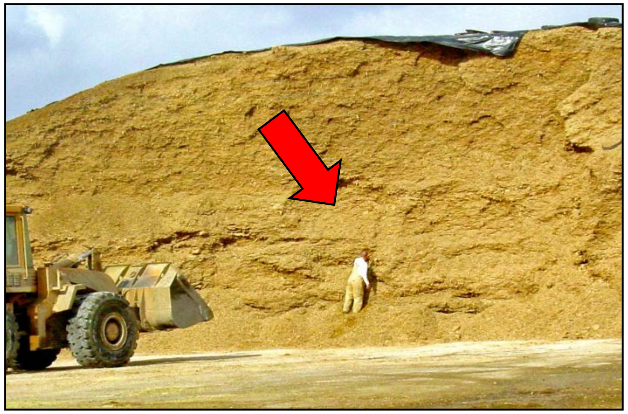
Bottom line … If a silage program is NOT safe, then nothing else about it really matters in the end.



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Keith, June 2017

I was asked by a producer to help with his high moisture corn, and we needed to do some lab analysis. And there isn't a soul around the bunker silo.

Two years ago, I would have walked up to the face and taken a sample. One look today, because of you and Ruthie, and I said ‘no way’.

I pulled the sample with a spear from the top of the bunker and a long way back from the feed-out face.

Thank you for making me think!

Wade Patterson,
Lallemand Animal Nutrition

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Safe Silage

Efficient Silage

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Guidelines that promote safe silage management practices and reduce the risk of a serious accident or fatality from a silage avalanche include:

- **Bunker silos and drive-over piles should not be filled higher than the unloading equipment can reach safely. Note: Typically, a loader can reach 12 to 14 ft.**
- **Never allow people to approach the feed-out face. *No exceptions!***
- **Never stand closer to the feed-out face than three times its height. *No exceptions!***
- **Suffocation is a primary concern and likely cause of death in many silage avalanche accidents, so follow the '*buddy rule*' and never work alone in a bunker or pile.**
- **Never dig the loader bucket into the bottom of the silage. Note: Undercutting creates an overhang that can loosen and tumble to the floor.**
- **If the loader must be driven close to the feed-out face in an over-filled bunker or pile, the *'buddy rule'* should be strictly enforced. *No exceptions!***

Guidelines that promote safe silage management practices and reduce the risk of a serious accident or fatality from a silage avalanche include (cont.):

- **When standing on top of the silage in a bunker or pile, never be closer to the edge of the feed-out face than its height.**
- **Do not "pitch" surface spoilage. It is simply too dangerous to remove spoilage from the top of many bunkers and piles.**
- **When removing plastic or oxygen-barrier film, tires, tire sidewalls or gravel bags from an over-filled bunker or pile; use caution, wear a safety harness, and be tethered with a heavy rope or cable.**
- **Never park vehicles or equipment closer to the feed-out face than three times its height. *No exceptions!***
- **Take silage samples from a loader bucket at a safe distance from the feed-out face.**
- **If a new crop is packed against an existing silage face, clearly mark where the two silages join. Note: Use caution when the feed-out face approaches the joined area.**

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Guidelines that promote safe silage management practices and reduce the risk of a serious accident or fatality from a silage avalanche include (cont.):

- **Post warning signs around the perimeter of bunkers and piles saying, '*Danger! Silage Face Might Collapse*'.**
- **If a bunker or pile is in a remote area on the farm, the perimeter should be fenced and a sign posted saying, '*Danger: Do Not Enter. Authorized Personnel Only*'.**

The bottom line in preventing avalanche tragedies includes:

1) Avoid excess height when filling bunker silos and building drive-over piles.

2) Avoid working or standing close to the feed-out face.

3) Avoid becoming complacent! Always pay attention to your surroundings and *never think that an avalanche cannot happen to you!*

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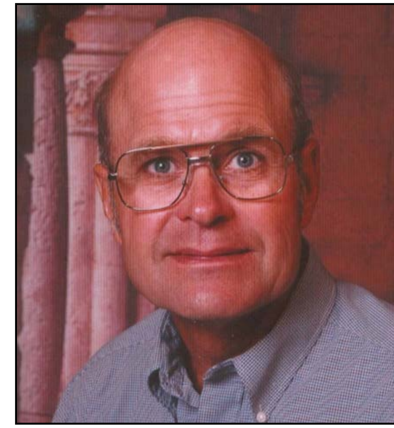
Personal communication from Rich Porter.

Farmer and rancher, Reading, KS.

(February 16, 2017)



I parked the front of my pickup about 12 feet back from the face of a bunker silo that was about 14 feet high. While I was standing about 30 yards away talking to an employee, the silage collapsed. It hit the hood of my truck hard enough that one could easily see the outline of the air cleaner. This supports the recommendation to stay much farther away from the silage feed-out face than the face is tall.

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Fatigue – It's going to happen …

Getting people ready for the silage-making season is just as important as preparing the equipment for the task.

- **A meeting with all parties involved before the silage season begins can help re-focus everyone on those tasks that might not have been considered since the previous year.**

- **The long hours of harvesting, transporting, filling, packing, and covering silage in bunker silos and drive-over piles increase the risks of fatigue, drowsiness, and even illness.**

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Fatigue (cont.)

Here are guidelines that promote both a safer work environment and a safer working day during the silage season:

1. The silage team should be properly sized to perform all tasks safely. Note: It might be tempting to work with a smaller crew for longer hours, but this is not a good money saver if it increases the risk of a serious injury accident.

2. Everyone should get a good night's sleep, because tired equipment operators are more likely to make mistakes. Note: According to research, most people are 'hard wired' to need 8 to 9 hours of sleep per night. Any amount less than that, especially night after night, can impair function and significantly reduce reaction time.

3. Periodic breaks of 15 - 20 minutes are effective in keeping employees alert.

4. Rotate work shifts to keep employees rested and alert.

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Fatigue (cont.)

5. Provide nutritious meals for all employees on a regular schedule throughout the day and every day.

6. Employees should carry snacks and plenty of water. Note: Do not overlook the importance of staying hydrated.

7. Extra persons, especially children, and uninformed bystanders should be kept out of the way of the silage making and feeding activities at all times.

8. People standing close to loud, powerful forage harvesters, trucks, tractors, and feed-out equipment only add distractions to the many responsibilities of the equipment operators.

9. Neither bystanders nor children are likely to appreciate the potential dangers of being near the equipment or the possibility of being buried by a silage avalanche.

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The KEITH BOLSEN SILAGE SAFETY FOUNDATION is a nonprofit corporation dedicated to promoting safe silage management practices for bunker silos and silage piles, as well as providing educational resources and materials for the global silage industry. The goal of the foundation is for everyone involved in a silage program on farms, dairies, feedlots and other livestock operations to return home to his or her family safe everyday.

www.silagesafety.org

The Keith Bolsen Silage Safety Foundation's first "on-farm" safety workshop was held on Friday November 10, 2017 at Table Rock Farm.

Table Rock Farm in Castile, NY

1,200-cow dairy

Willard DeGolyer

Meghan Hauser

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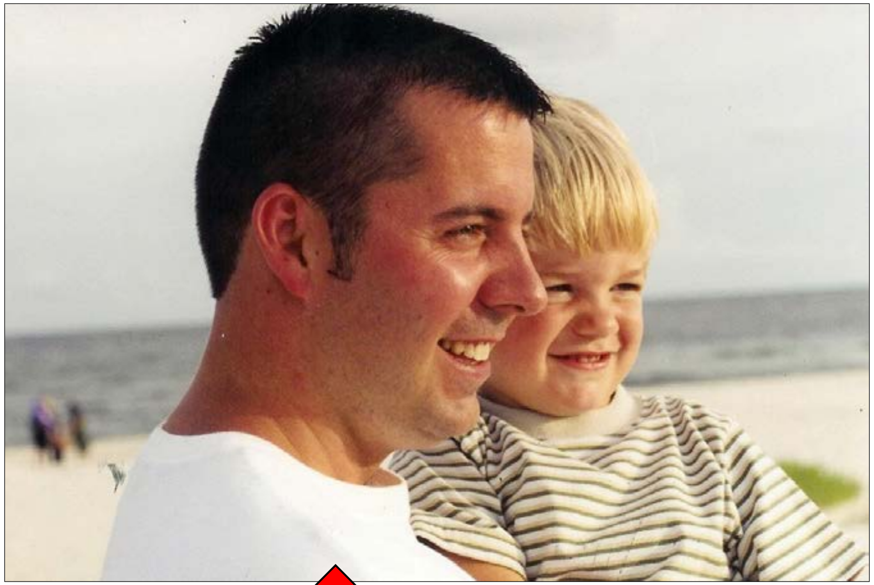
ACCIDENTS change LIVES and FAMILIES … FOREVER!

Glen Jantzen, Silage Contractor, Plymouth, NE



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Date: September 27, 2017 at 9:00 AM CST
To: 'Ruth Bolsen' ruthbolsen@me.com
From: Lane Leadingham

Thank you for caring about not only my son and the sadness that my family faces daily, but for all of the others before him and the ones still to be protected by your efforts.

I love you both, dearly!

Lane Leadingham City Bank Mortgage
Ruidoso, NM 88345

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THANK YOU

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Evaluating Dairy Diets from the Nutritionist, to the Employee, to the Cow

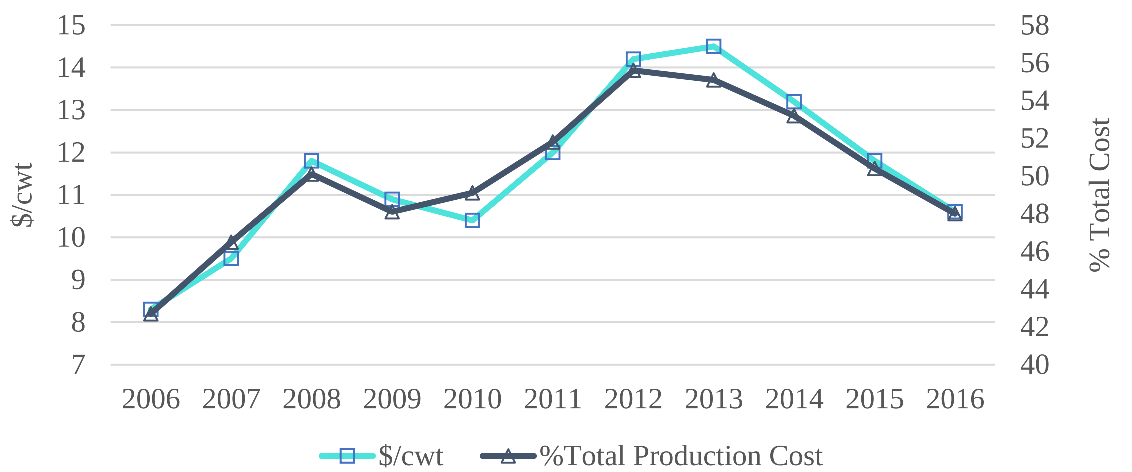
Authored by Fernando Diaz, DVM, PhD – Dairy Nutrition and Management Consultant at Rosecrans Dairy Consulting, fernando@jration.com

Co-presented by Tracey Erickson, SDSU Extension Dairy Field Specialist & Jim Salfer, U of M Regional Extension Dairy Educator.

Introduction

Feed continues to be the highest individual cost in confined dairy production systems. According to the USDA Economic Research Service (2017), during the last decade feed costs represented in the US between 42 and 57 percent of the total cost of producing milk (Figure 1). With feed comprising the largest operating expense, nutrition and feeding management practices are the key profit drivers for most dairies. To enhance profitability, it is very important to reduce feed costs without negatively affecting cow production, health or reproduction.

Figure 1: Feed costs of production



The following feeding management practices need to be addressed to implement a successful feeding program:

1. Dry matter content adjustment of silages

Researchers from Ohio State University evaluated the short-term dry matter (DM) variation in corn and hay-crop silages on 8 farms near Wooster, OH (Weiss et al., 2012). Corn silage samples taken daily during a 14-day period had a range in DM concentration of 7.3 percentage units. Dry matter concentration ranged by 5.1 percentage units in the most consistent corn silage and by 10.4 units in the most variable. For hay-crop silage, DM was most variable, with an average range of 11.8 units (3.4-19.1).

Recommendation: Test silages daily, and adjust DM if the new estimation differs by more than one percentage point from the previous DM.

2. Feeding accuracy

Researchers from Virginia Tech demonstrated that 4% of all total mixed ration (TMR) loads were underfed by more than 400 pounds in 9 dairy farms located in the Chesapeake Bay (James and Cox, 2008). On the other hand, frequency of overfeeding in excess of 400 pounds was 33 %.

Similarly, researchers form California (Trillo et al., 2016) evaluated dairy feeder performance based on loading deviations from target weight. The study included 26 dairies that ranged in size from 1,100 to 6,900 cows. Feeding records included information from more than 500,000 ingredient loads were obtained throughout a 12-month period from the feeding software. In summary:

- In 2.5% of the total loads, ingredients were loaded under the target weight set by the tolerance level, representing between 0.1 to 21.1% loads of feed per dairy.
- When expressed in pounds, at least 20% of the time ingredients were loaded with a deviation from target >80 lbs. on 7 dairies or <− 80 lbs. on 2 dairies.
- Rolled corn and almond hulls were loaded with adequate precision and adequate accuracy while alfalfa hay, corn silage, and canola were loaded with poor precision.
- As result of deviations from the target weight, the ration cost increased by at least $3 per metric tonne <5% (15 dairies), 5 to 20% (6 dairies), or >20% (2 dairies) of the times.

Recommendation for loading accuracy:

- Ingredients from upright bins: less than 15 lbs. fresh matter (FM)
- Ingredients from open-sided commodity sheds: less than 25 lbs. FM
- Dry hay: less than 25 lbs. FM

- Silages and wet corn co-products (30 – 60% DM): less than 50 lbs. FM

3. First time feeding

Fresh TMR should be delivered each day at the same time. If the TMR is delivered one hour late of the schedule, the cows will have 4% more time to consume the feed, and the feed-bunk may be emptied before the fresh TMR is dropped. On the other hand, the weigh-backs will be in excess the next day.

Recommendation: A deviation of less than 10 minutes from the scheduled feeding time, and clean-out the feed-bunks within 10 minutes of fresh TMR delivering.

4. Weigh-backs

One of the areas of focus for reducing feed costs is the amount of feed weigh-backs (refusals, orts) generated daily in the farm. Previous management recommendation of keeping a weigh-back of about 5% is no longer feasible in the current economic environment. At current feed costs of $0.12 per lb. of dry matter (DM), overfeeding a high production cow 3 – 5% extra increases daily feed costs by $0.20 – 0.40 per day or $73 – 146 per year. Part of that expense may be recovered if the weigh-backs are fed to other groups of animals (such as late-lactation, heifers, dry cows) or sold to other beef or heifer operations; however, the value of the weigh-backs is always lower than the original TMR. In addition, during warm weather (May-September), the weigh-backs sometimes have to be discarded due to spoilage. Therefore, there are economic benefits of feeding for low weigh-backs as long as overall cow performance is not affected.

Three recent research studies showed that this strategy is becoming more popular in the dairy industry:

- An observational study conducted by the University of Guelph evaluated feeding management practices and milk production in 22 freestall herds located in eastern Ontario, Canada (Sova et al., 2013). The authors indicated that herds were feeding for low feed weigh-backs, with 32% of herds feeding for less than 2% weigh-back and 73% feeding for less than 5%.
- A feed management survey including data from 120 California dairies (Silvia-del-Rio et al., 2010) reported that targeted weigh-backs were: 2% or less (50% of the producers), 2 to 5% (34%), or more than 5% (16%).

- In an observational study performed in 50 freestall dairy farms in Minnesota, most producers indicated feeding for a maximum of 5% weigh-backs, with some targeting 2 to 3% (Endres and Espejo, 2010).

French et al. (2005) conducted a controlled trial to evaluate the effects on lactating cow performance of feeding for two different weigh-backs (3.4 and 5.5%). Cows were housed in freestalls and fed individually. They could find no statistical differences in daily DM intake (56.3 and 57.4 lbs/day), 3.5% fat-corrected-milk (91.3 and 93.4 lbs./day), and feed efficiency (1.57 and 1.56 lbs. 3.5% FCM per lb. DM offered) for 3.4 and 5.5% weigh-back rate, respectively. In addition, the feed-bunk management strategy did not affect number of meals per day (7.7) or DM intake per meal (7.5 lbs). These findings were corroborated on the observational study from the University of Guelph cited previously (Sova et al., 2013). The authors found that weigh-backs from 22 commercial herds (average: 3.5%; minimum: 0.87%; and maximum: 9.3%) were not associated with milk yield, DM intake or feed efficiency.

On the other hand, having the bunk empty could cause slug feeding and produce adverse effects on milk production and cow health. Bach at al. (2008) carried out a study to determine the effect of non-dietary factors in 47 dairy herds that were fed exactly the same lactating rations. Herds fed to ensure feed weigh-backs tended to produce 3.5 lbs. more milk daily than those that did not allow feed weigh-backs.

<u>Recommendation for weigh-backs:</u>

- 2 - 3% on milking pens
- 0 - 2% on far-off pens
- 8 - 10% on close-up and fresh pens

5. Feed push-ups

Frequent and scheduled push-ups to ensure all cows have feed within their reach at all times is essential. Feed push-up frequency was evaluated in the feeding management studies discussed previously:

- Ontario: Feed push-up frequency ranged from 0 to 20 times/day, with an average frequency of 4.6 times/d (36% of herds pushed-up feed less than 4 times/d).

- Minnesota: The frequency of feed push-up was 5.4 times daily (range 3–12).
- California: Feed was pushed daily between 1 and 4 times (47.7% of dairies), 5 and 8 times (42.4%), and 9 or more times (9.9%).

Overall, these data indicate more attention should be paid to feed push-ups in North-American commercial dairies. When feeding for low weigh-backs, push-ups during the 4 – 5 hours before delivering fresh feed is required because the amount of feed available is becoming scarce. Moreover, to keep TMR available at each feed station the TMR should be evenly distributed along the feed-bunk.

Recommendation: Daily feed push-ups scheduled once per hour.

6. Sorting behavior

Dairy cows selectively consume their rations, generally sorting against longer particles and in favor of finer particles. Feed sorting decreases fiber intake while increasing the consumption of grains and co-products. It also allows them to eat different rations throughout the day.

Two studies have evaluated sorting behavior in commercial dairies located in North America. Researchers from University of Minnesota (Endres and Espejo, 2010) evaluated ration change over time in 50 Minnesotans freestall barns. At each farm, samples of TMR were collected from the high production cow feedbunks. One sample was collected immediately after TMR was delivered, three additional samples were collected every 2 to 3 hours after feed delivery, and the last sample was taken from the accumulated weigh-backs. They evaluated particle size in the TMR samples using the 3-sieve Penn State Particle Separator (19-, 8- and 1.18-mm screens). On average, the researchers found a noticeable change in the percentage of material retained in the top screen from the initial TMR to the weigh-backs (11, 13, 15, 17, and 23% on the initial sample, 2nd, 3rd, 4th sample, and weigh-backs, respectively) showing cows were selecting against long particle size. As results, fiber content (% NDF) of the TMR increased along the day [(30.6% on the initial TMR, 32.3% (2^{nd}), 33.3% (3^{rd}), 34.0% (4^{th}), and 37.4% on the weigh-backs)].

Similar results were obtained in the Canadian survey including 22 freestall herds (2013). On average, the refused ration was higher in the percentage of long particles recovered in the top screen (19.8 vs. 33.1%) and physically effective NDF (17.0 vs. 24.5% DM) than the average offered ration.

Feed sorting causes fluctuations in rumen fermentation patterns, and may result in reduced ruminal pH and episodes of subclinical ruminal acidosis. A study published recently (2017) showed the association between sorting behavior and milk production. The researchers evaluated feeding behavior in 28 lactating Holstein cows individually housed in a tiestall barn at the University of Guelph, Kemptville Campus Dairy Research and Innovation Center. Particle size distribution in offered diet was 8.0% long particles (>19 mm), 53.5% medium particles (8 – 19 mm), 29.1% short particles (1.18 – 8 mm), and 9.4% fine particles (<1.18 mm).

Cows sorted against long particles and in favor of short and fine particles. On average, intake of the longest particles, expressed as a percentage of the predicted intake, was 78% (ranged from 45 to 103%). Milk production on the group was 90.6 lbs./day with 3.81% and 3.30% protein. The authors found negative associations between feed sorting and milk composition, every 10% increase in sorting against long particles, milk fat and milk protein contents decreased by 0.10 and 0.04 percentage units, respectively.

Since the average sorting against long particles in the group was 22%, milk fat was reduced by 0.22 percentage units or 0.2 lbs/cow/day due to sorting. Similarly, milk protein was reduced by 0.09 percentage units or 0.08 lbs/cow/day. Using values from September FMMO Advanced Component prices (fat $3.03/lb. and protein $1.54/lb.), the economic impact of sorting in this research herd was 72 cents per cow day or $263 per year.

Factors may make a diet prone to sorting:

- Dry matter content
- Particle size of forages, mainly dry hays
- Variation in density of feed ingredients
- Sequencing of loading ingredients into the mixer
- Frequency of feeding
- Feed availability in the feed-bunk (push- ups)

Conclusion

Feeding management practices affect considerably farm profitability, and production of milk fat offers a potential to enhance income in dairies. High-producing herds require a high level of feeding management to assure the supply of a consistent diet available in the feed-bunk at all times. Management practices such as feeding and push-up times, ingredient loading accuracy, and DM determination on silages are the main areas in which to focus. Moreover, feed sorting behavior should be avoided because produces health issues in the cows and economic losses in the herd.

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