Professional Dairy Producers of Wisconsin: Production and Management Symposium

Appleton, WI 11-18-08

Avoiding Common Silage Pitfalls

1. Pack 2. Seal 3. Deliver

4. Pitch 5. Be Safe

K-STATE Kansas State University

Keith Bolsen Ph.D. & Associates

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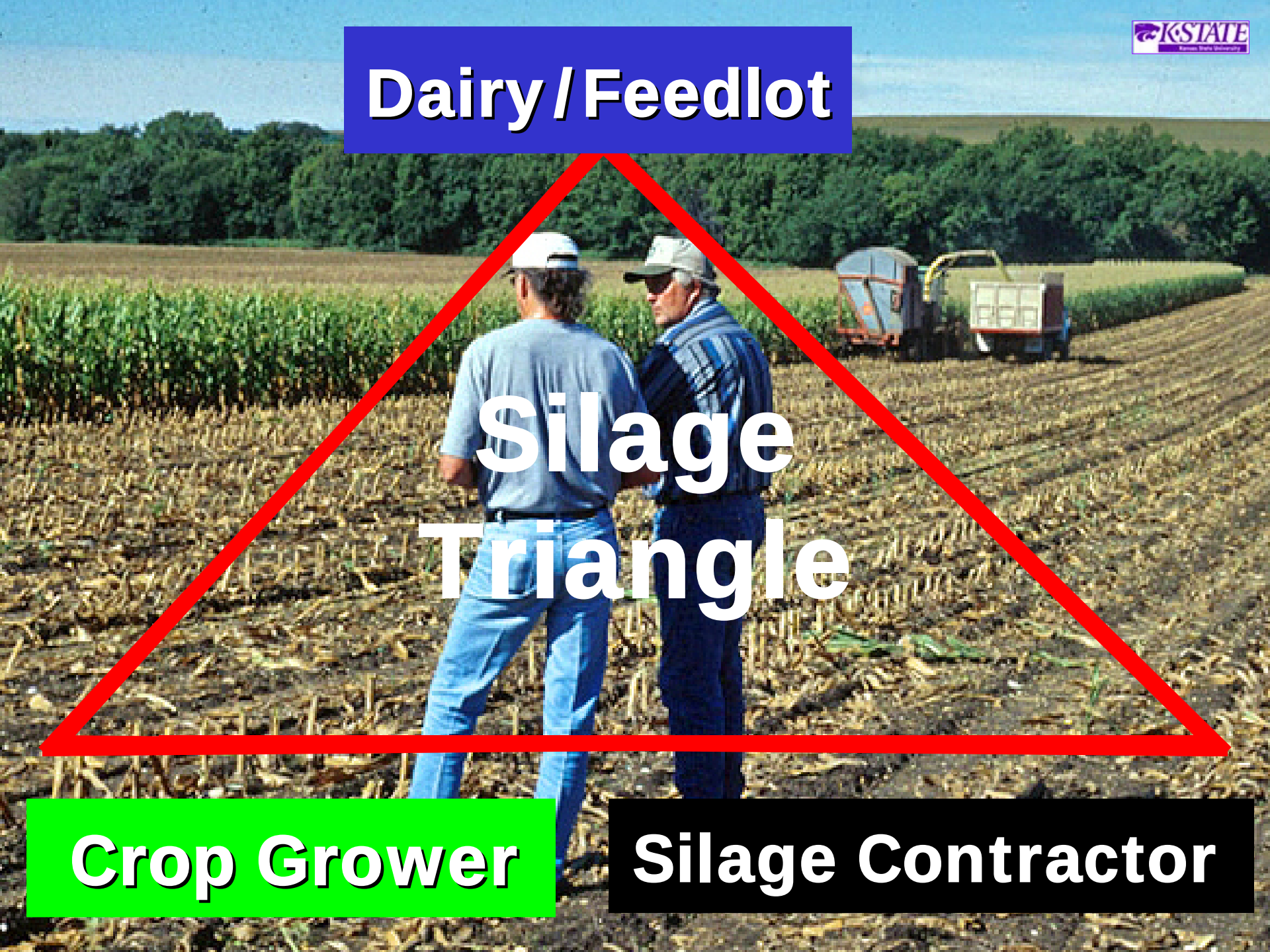
www.oznet.ksu.edu/pr_silage *ruthbolsen@austin.rr.com*

PD PW

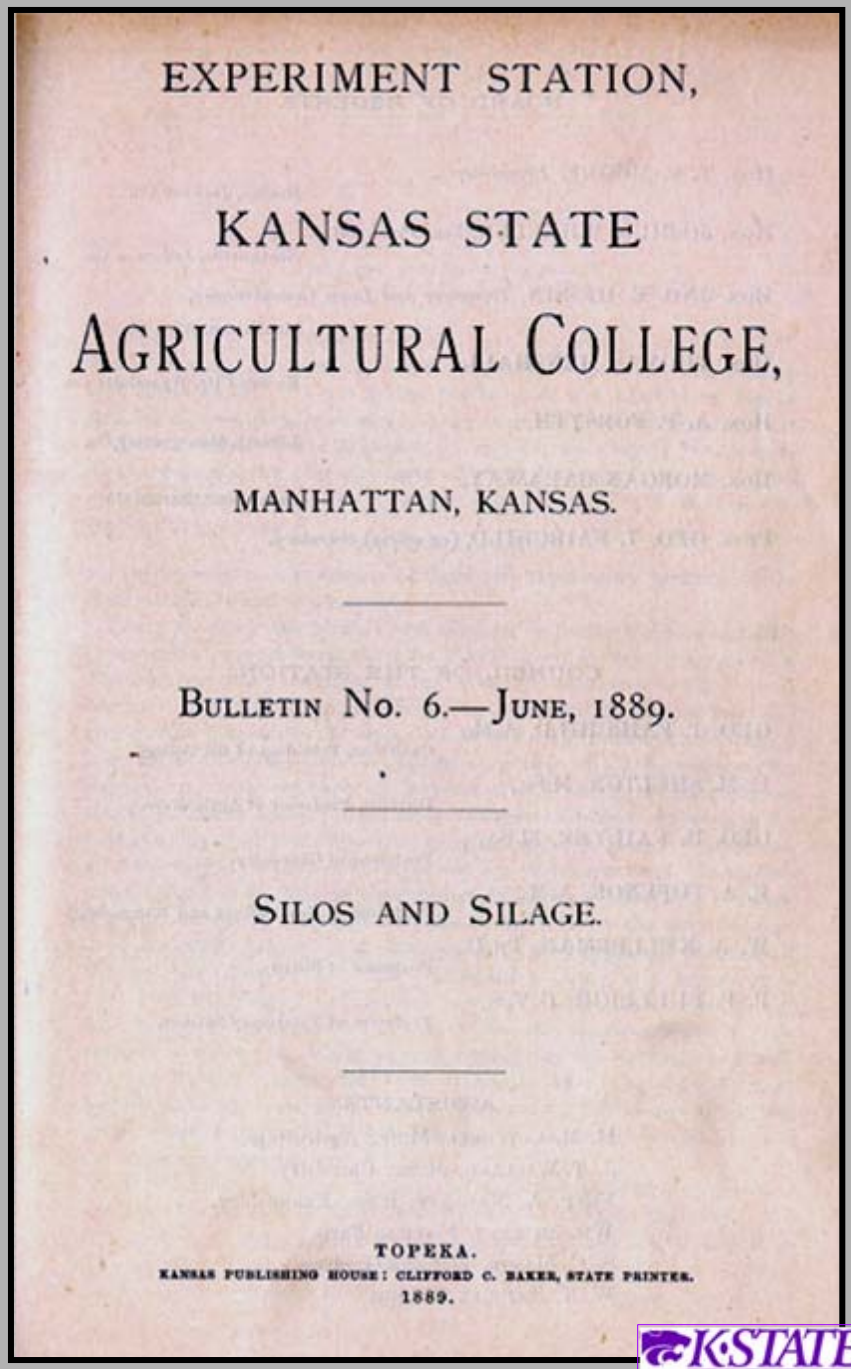

Dairy / Feedlot
Silage Triangle
Crop Grower
Silage Contractor

Silos and Silage

Bulletin No. 6 in 1889

Reported cattle performance and sources of loss in an 80 ton capacity tower silo.

Seven % of the weight of the whole-plant corn ensiled vs. weight of silage removed could not be accounted for, so the authors explained it as a loss by ‘evaporation’.



EXPERIMENT STATION,

KANSAS STATE

AGRICULTURAL COLLEGE,

MANHATTAN, KANSAS.

BULLETIN No. 6.—JUNE, 1889.

SILOS AND SILAGE.

TOPEKA.

KANSAS PUBLISHING HOUSE: CLIFFORD C. BAKER, STATE PRINTER.

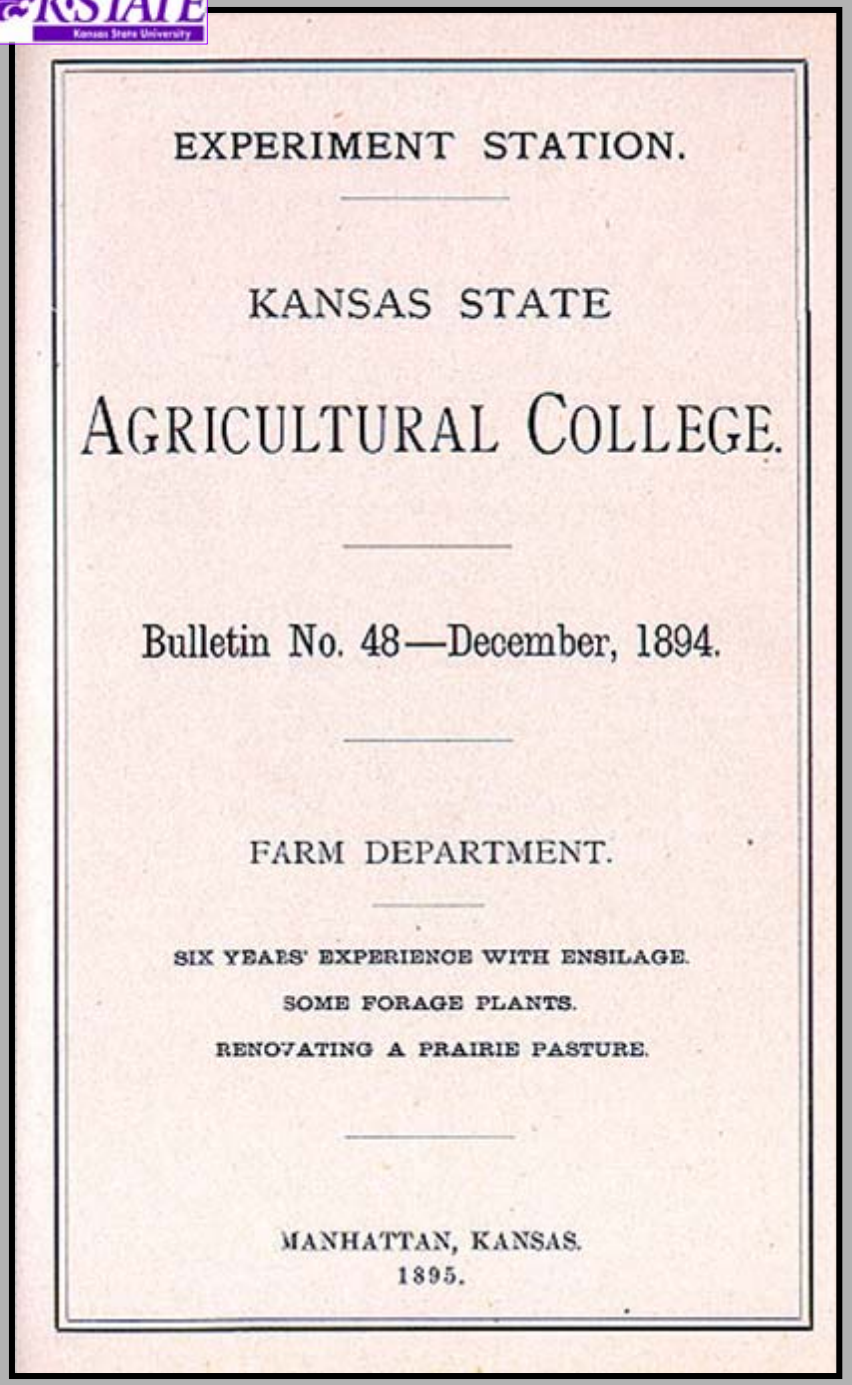
1889.

Experiences with Ensilage

Bulletin No. 48 in 1894

77% of the forage ensiled was 'sound' and 'available for feeding'.

Shorter chop lengths of ½ inch compared to 1 inch resulted in 'closer packs' and cattle 'ate it up cleaner'.



EXPERIMENT STATION.

KANSAS STATE

AGRICULTURAL COLLEGE.

Bulletin No. 48—December, 1894.

FARM DEPARTMENT.

SIX YEARS' EXPERIENCE WITH ENSILAGE.

SOME FORAGE PLANTS.

RENOVATING A PRAIRIE PASTURE.

MANHATTAN, KANSAS.
1895.

What is the "Market Value" of Corn Silage based on Shrink Loss alone?

- $50 / ton ÷ 95.0% = $52.63
- $50 / ton ÷ 90.0% = $55.55
- $50 / ton ÷ 85.0% = $58.82
- $50 / ton ÷ 80.0% = $62.50
- $50 / ton ÷ 75.0% = $66.66
- $50 / ton ÷ 70.0% = $71.43

"Forage In" vs. "Silage Out"

HOW TO ACHIEVE A "SINGLE DIGIT" SHRINK?

- ✓ Schedule regular meetings with your entire TEAM.
- ✓ Select the right forage hybrid or variety.
- ✓ Harvest at the optimum stage of maturity & whole-plant DM content.
- ✓ Use the correct size of bunker or pile, & do not over-fill bunkers or piles.
- ✓ Apply the appropriate inoculant at the forage chopper.
- ✓ Employ experienced people, especially those who operate the forage harvester, blade/push tractor or bagging machine. Provide training as needed.
- ✓ Achieve a high, uniform packing density of at least 15 lbs of DM per ft^3.
- ✓ Provide an effective seal to bunkers and piles, & consider using double plastic sheets or a new oxygen barrier film (Silostop).
- ✓ Follow proper face management practices during the feedout/delivery period.

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It‘s

‘not a perfect world’

… dairy producers

know problems can occur in

***every* silage program.**

Avoiding Common Silage Pitfalls

1. Achieve a higher silage DM density
2. Apply the best seal
3. Manage the delivery

Why? Reduce 'Shrink loss'!!

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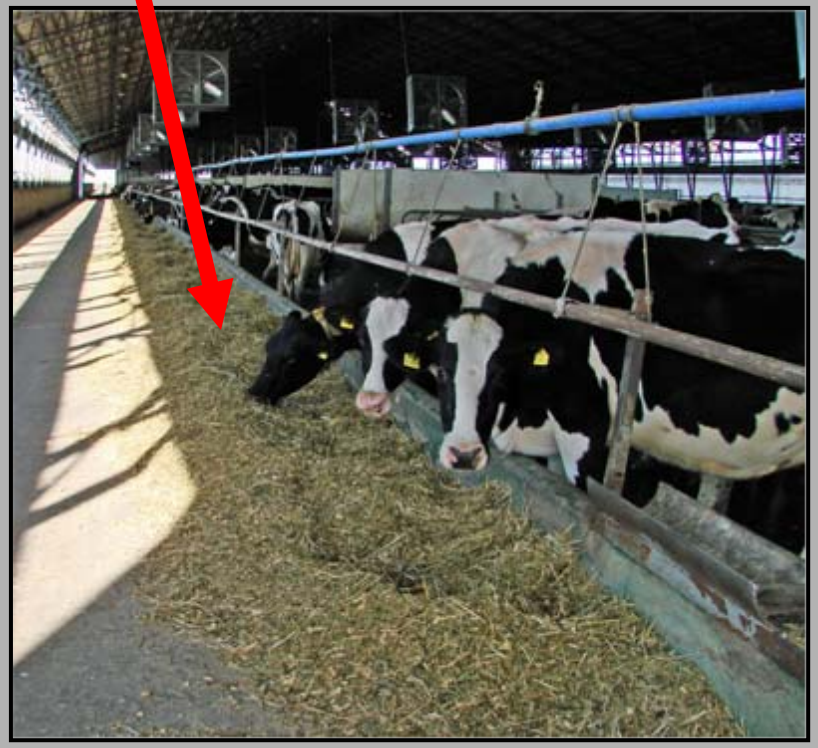
& Associates

DM Losses (% of the Ensiled DM) and their Causes

Residual respiration	U	1 - > 4	O_2 & plant enzymes
Fermentation	U	2 - > 6	Microorganims
Effluent	A	0- > 5	Low DM content
Secondary fermentation	A	0- > 5	Forage, silo, & DM content
Aerobic spoilage in storage	A/U	1- > 10	Forage, silo, density, & sealing
Aerobic spoilage at feedout	A/U	1- > 10	Feedout technique
TOTAL		5- > 40	

U = unavoidable and A = avoidable.

Zimmer, 1980



Basic Principles of Silage

Four Phases:

1. AEROBIC
2. FERMENTATION
3. STORAGE
4. FEEDOUT

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Biochemical changes in the ensiling process are from:

- Plant enzymes
- Lactic acid bacteria
- Enterobacteria
- Clostridia
- Yeast / mold / aerobic bacteria

Have a negative impact on silage!!

McDonald, 1980

1. AEROBIC

Oxygen + respiratoy enzymes

act on

Sugars

produce ⟶ CO_2 + **HEAT**

1. AEROBIC

Plant protease enzymes

act on

Proteins

produce ⟶ soluble N

Biochemical changes in the ensiling process are from:

- Plant enzymes
- Lactic acid bacteria
- Enterobacteria
- Clostridia
- Yeast / mold / aerobic bacteria

Heterofermenters

Homofermenters

Have a negative impact on silage

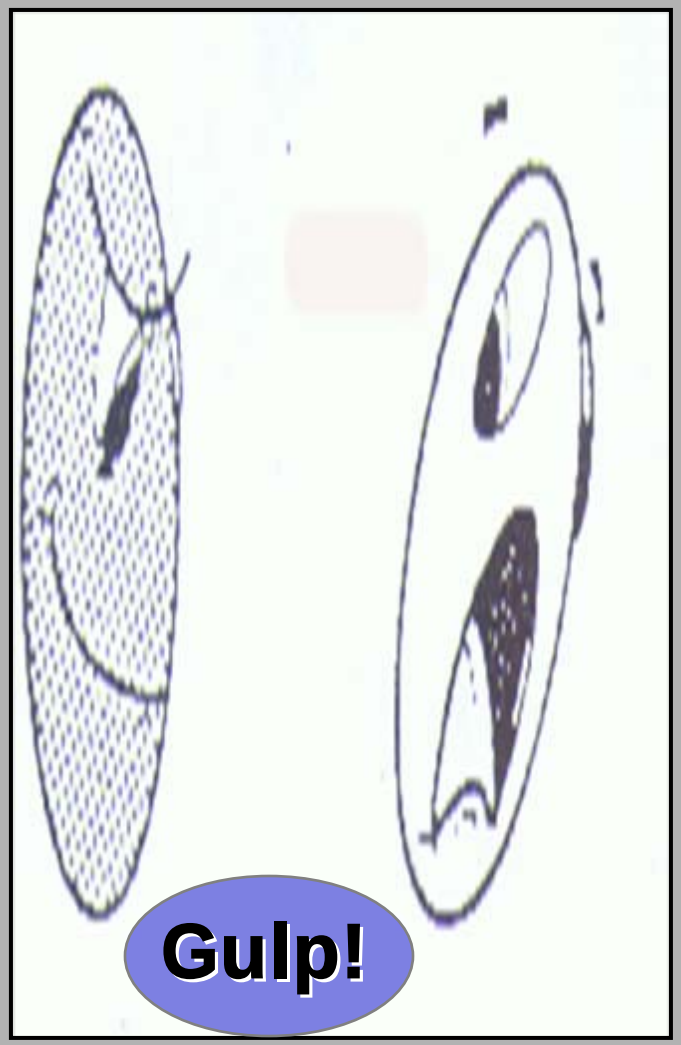
McDonald, 1980

2. FERMENTATION

Enterobacteria

consume

Sugars



And produce

↓

Lactic acid

+

Acetic acid

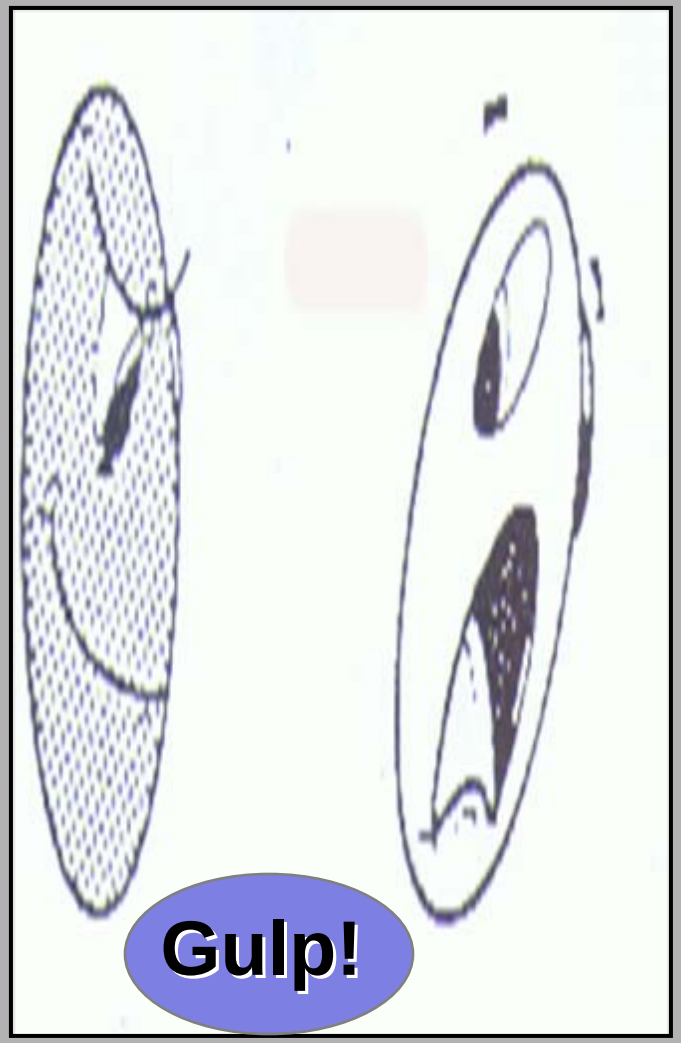
(a RED FLAG!)

2. FERMENTATION

Heterolactic
Lactic acid bacteria

consume

Sugars



And produce

↓

Lactic acid

+

Acetic acid

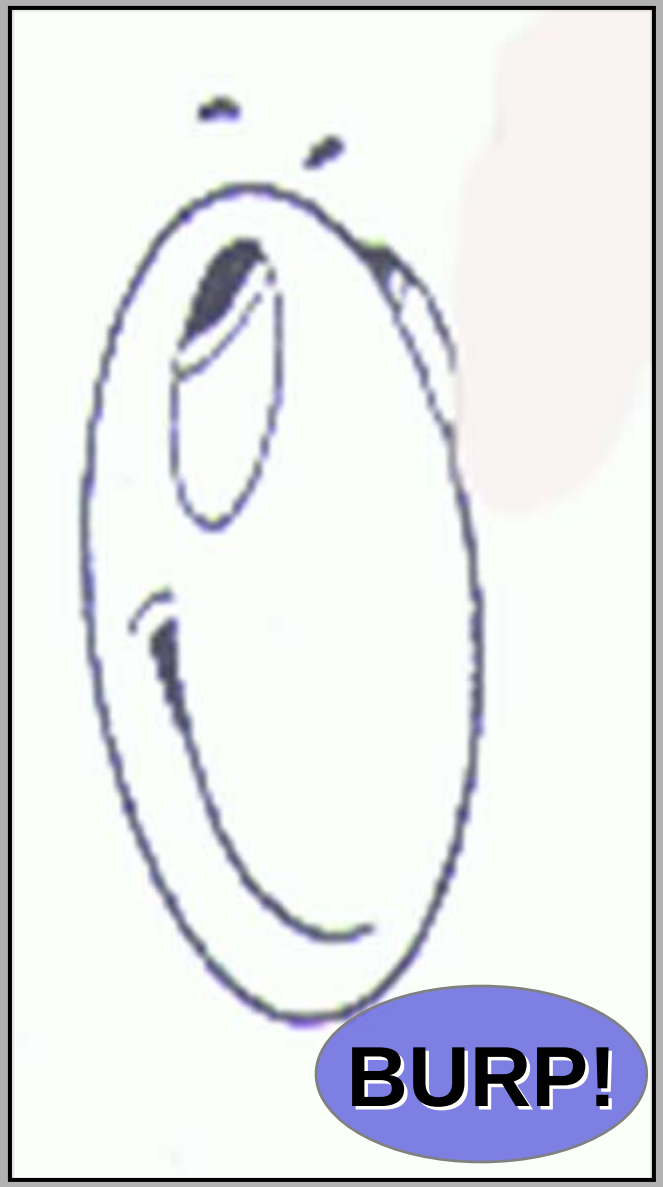
(a RED FLAG!)

2. FERMENTATION

Homolactic
Lactic acid bacteria

consume

Sugars



And produce ONLY

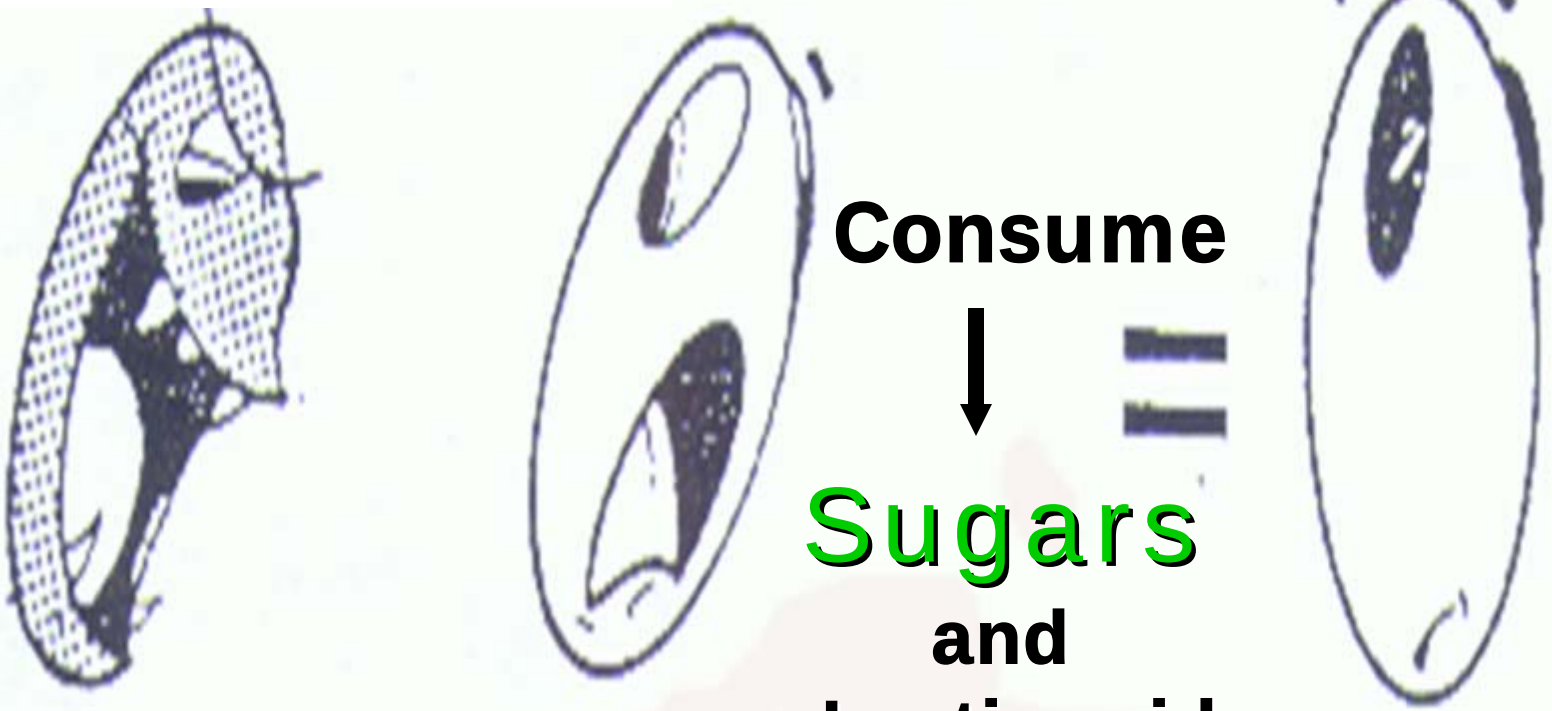
↓

Lactic acid

The "Good Silage" Acid

2. FERMENTATION

Clostridial spores



Consume

Sugars

and

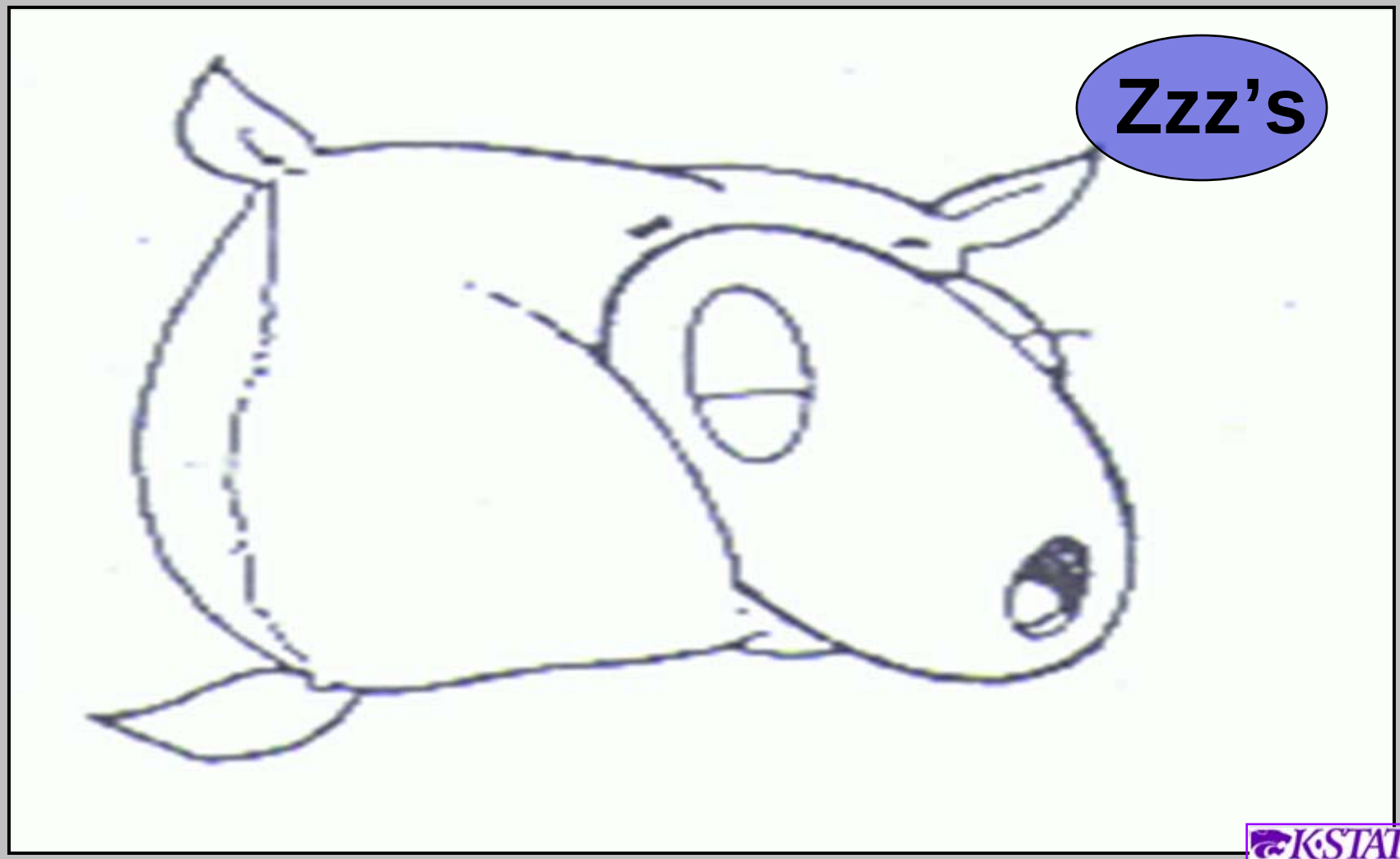
Lactic acid

produce → “butyric acid” and a “bad, evil-smelling silage”

Bottom Line:

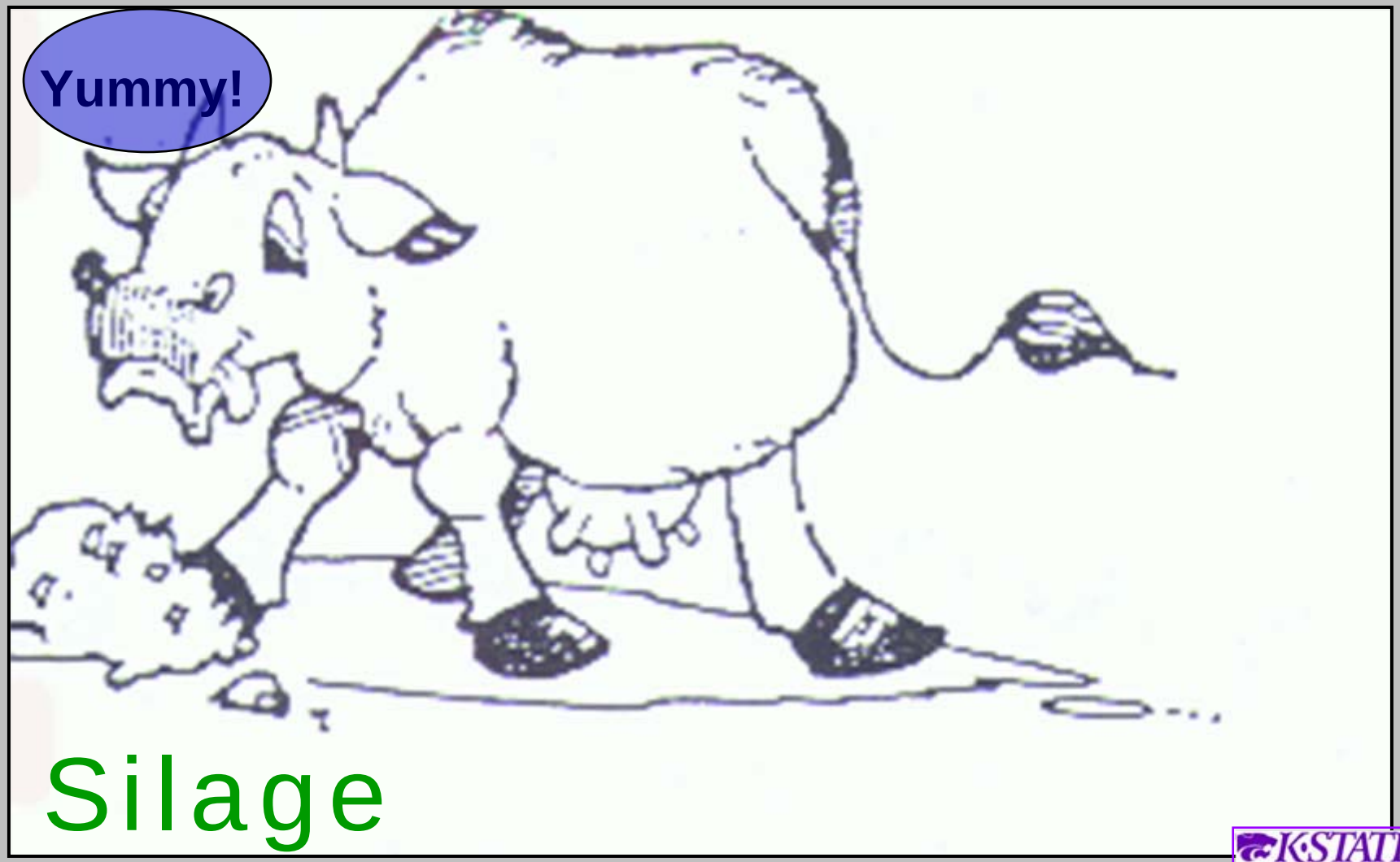
Clostridial, butyric acid-containing hay-crop silage is a <u>dairy heifer's</u> or <u>dairy cow's</u> worst nightmare!!

3. Stable Phase




Sealed?

4. Feedout Phase



How good are your Feeders?

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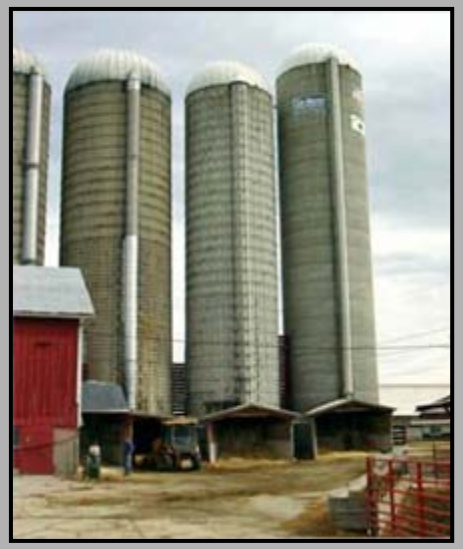
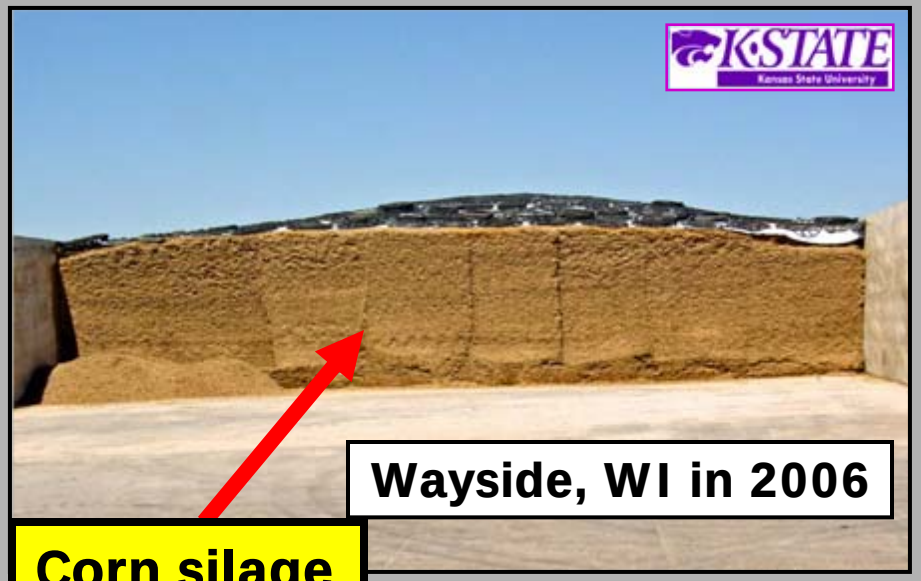
What can we learn from these PRODUCERS?



They all had a MEETING!

Whose SILAGE would you BUY?

Alfalfa haylage



Corn silage

Avoiding Common Silage Pitfalls

1. Achieve a higher silage DM density
2. Apply the best seal
3. Manage the delivery

Keith Bolsen Ph.D.
& Associates

Dry Matter Loss as Influenced by Silage Density: Adapted from Ruppel et al. (1995)

Density, lbs of DM per ft^3	DM loss at 180 days, % of the DM ensiled
10	20
12	18
14	16
16	14
18	12
20	10

Case Study Dairy with 7,000-ton pile of corn silage in April, 2004.

11.5 lbs of DM/ft^3 = 22.5% shrink in 2003.
Corn silage @ $40/ton

Spreadsheet Calculations of the Average Silage Densities in Drive-over Piles of Corn Silage on the *Case Study Dairy*.[1]

Component	Actual: 2003 corn silage	Predicted: 2004 corn silage
Bunker silo wall height, ft (0 for silage pile)	0	0
Bunker silo maximum silage height, ft	16	14
Forage delivery rate to bunker, fresh tons/hr	75	90
Forage DM content, %	0.32	0.34
Est. forage packing layer thickness, inches	8	5
Tractor # 1	35,000 (80)[3]	35,000 (80)[3]
Tractor # 2	0	35,000 (95)[3]
Proportioned total tractor wt, lbs	28,000	61,250
Avg silage height, ft	8.0	7.0
Estimated average DM density, lbs/ft^3	**11.5**	**15.8**

[1] Values in above the double line are user changeable. [2] Estimated packing time as a percent of filling time is shown in parenthesis.

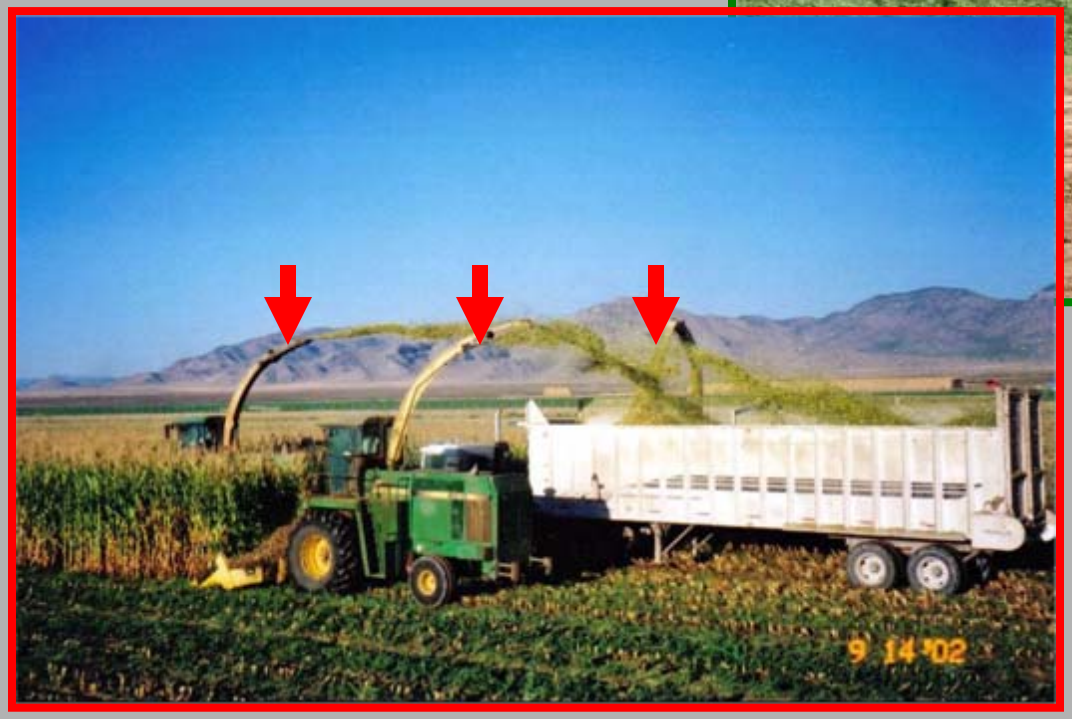
11.5 lbs of DM/ft^3 = 22.5% shrink in 2003.
15.8 lbs of DM/ft^3 = 15.0% shrink target in 2004.
An est. 525 tons of silage "saved" x $40/ton = $21,000

Cost to the dairy: 2nd pack tractor ($1.50/ton) = $10,500

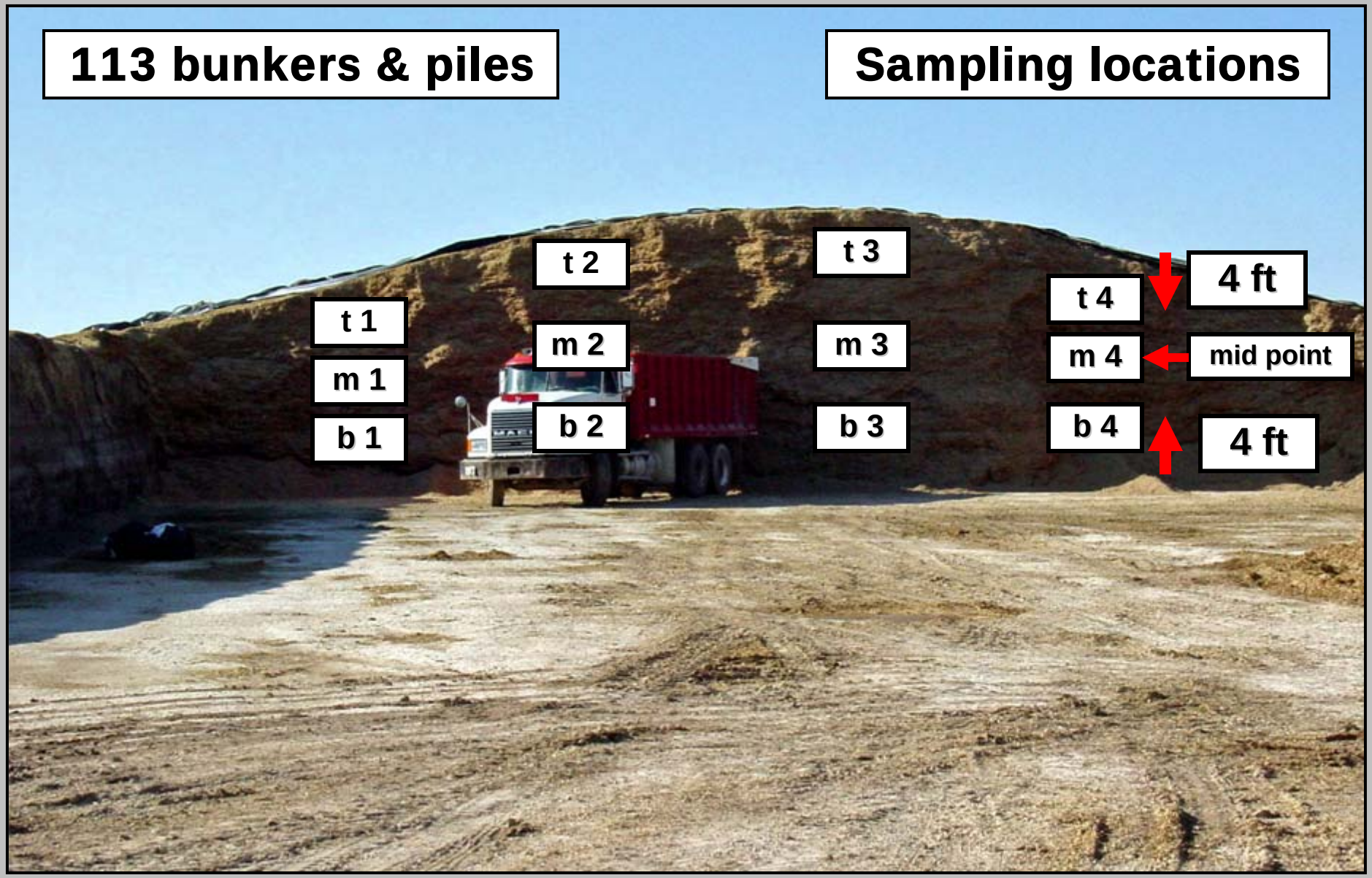
Estimated net benefit to the dairy: $10,500 (market value)

Does Your TEAM have a Michelangelo?

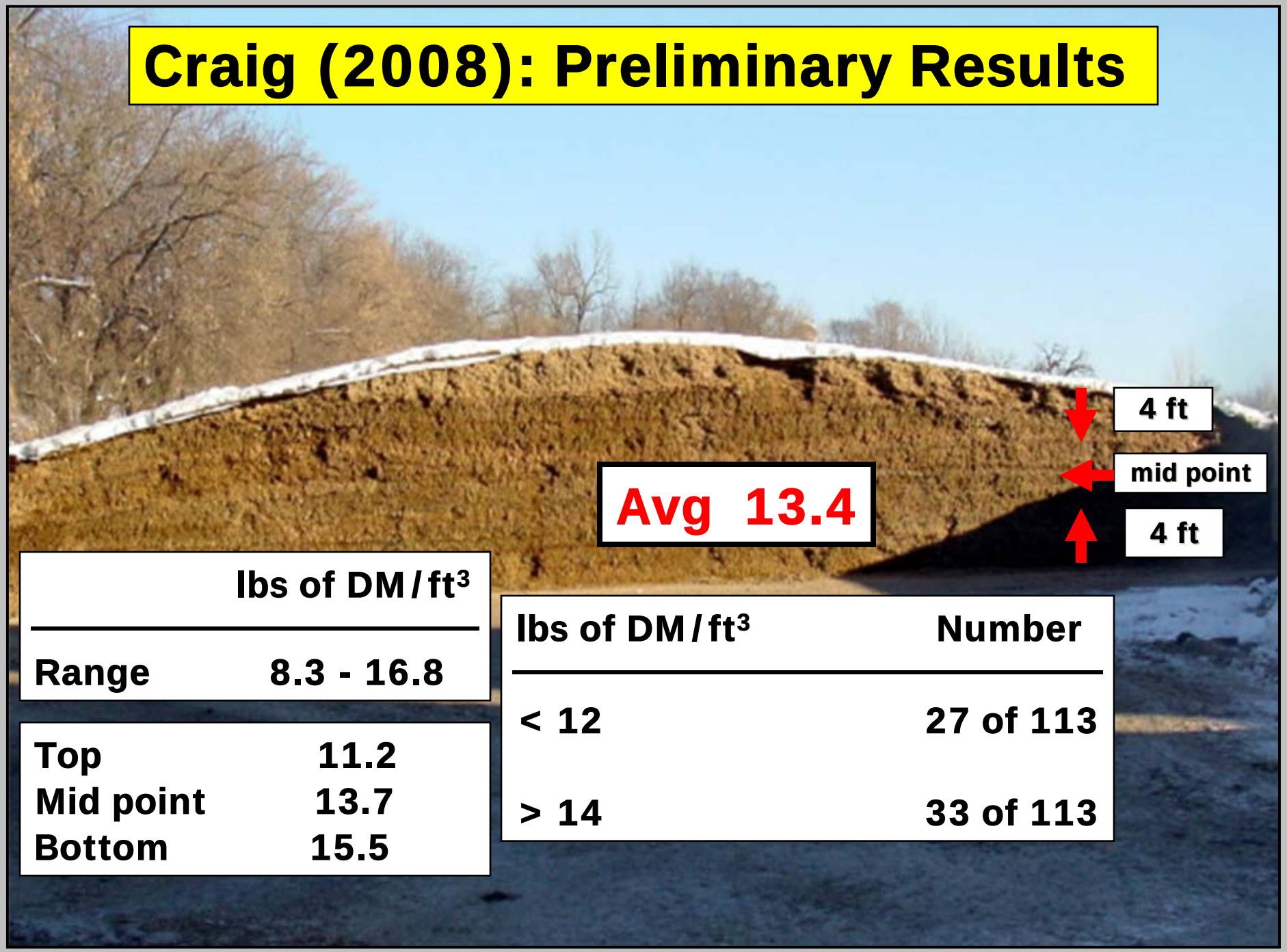
Chopper to pack tractor ratio: 2:1 or 1:2 ?



Craig, P. 2008. DM Density of Corn Silage in Bunker Silos and Piles. Penn State University.



Craig (2008): Preliminary Results



	lbs of DM / ft³
Range	8.3 - 16.8

Top	11.2
Mid point	13.7
Bottom	15.5

lbs of DM / ft³	Number
< 12	27 of 113
> 14	33 of 113

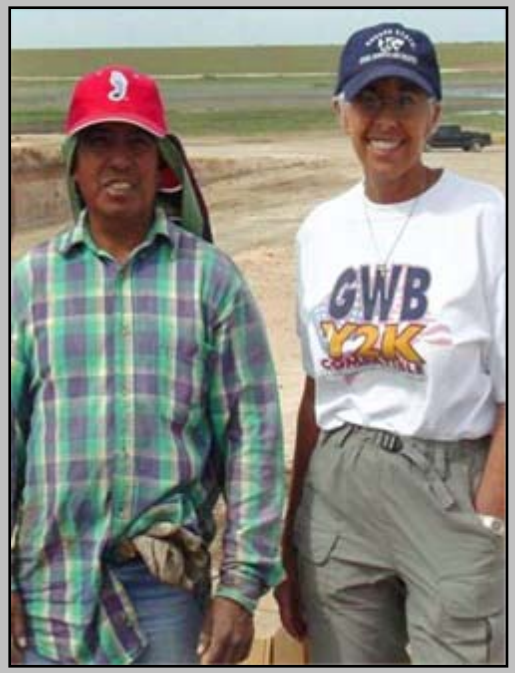
Avoiding Common Silage Pitfalls

1. Achieve a higher silage DM density
2. Apply the best seal
3. Manage the delivery

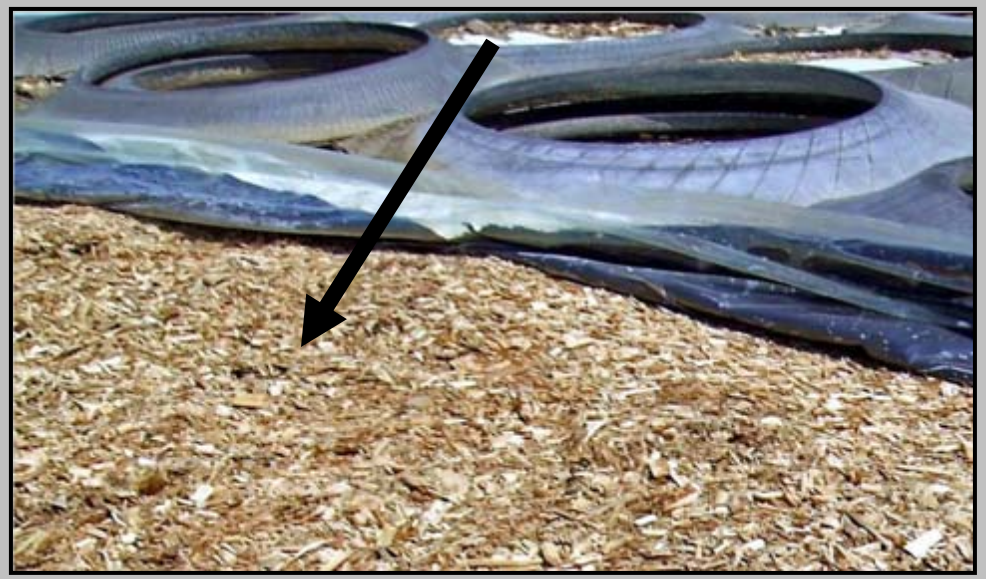
Keith Bolsen Ph.D.
& Associates

Not all silos are sealed, & not all seals are effective!

It can be a Dirty, Rotten, Lousy, Stinkin' Job ... PERIOD!



What can we learn from these PRODUCERS? They had a PLAN!!



Oxygen Barrier Film

www.silostop.com

SILOSTOP

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& Associates

SiloStop Field Trial: September 21, 2003

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Feedlot at Dimmitt, TX

SiloStop Field Trial: September 23, 2003

Feedlot at Garden City, KS

K-STATE Kansas State University

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& Associates

Comparison of 6-mil black plastic and Silostop on pH, fermentation profile, estimated additional spoilage loss of OM, and ash content in corn silage and HM corn at 0 to 18 inches from the surface at 240 days post-filling.

Keith Bolsen Ph.D. & Associates

	------ Corn silage ----		--------HM corn ------	
Item	Std plastic	Silostop	Std plastic	Silostop
DM content, %	29.2	31.6	72.3	73.2
pH	4.28	3.78	4.70	4.09
Est. OM loss[1,2]	27.3	8.4	12.6	7.2
	---------- % of the silage DM ----------			
Lactic acid	2.7	6.8	0.86	1.08
Acetic acid	2.6	2.2	0.25	0.31
Ash	11.2	9.1	2.10	1.98

[1] Values are estimated additional spoilage loss of OM, which were calculated from ash content using the equations described by Dickerson et al. (1992a).
[2] Ash content of the face samples was 8.4% for the corn silage and 1.85% for HM corn.

June 1, 2004

Value of corn silage in the top 3 feet @ $55 per ton = $175,560

Net saved with std plastic = $52,345

Net saved with Silostop = $71,330

Net benefit with Silostop = $18,985

Feedlot at Dimmitt, TX

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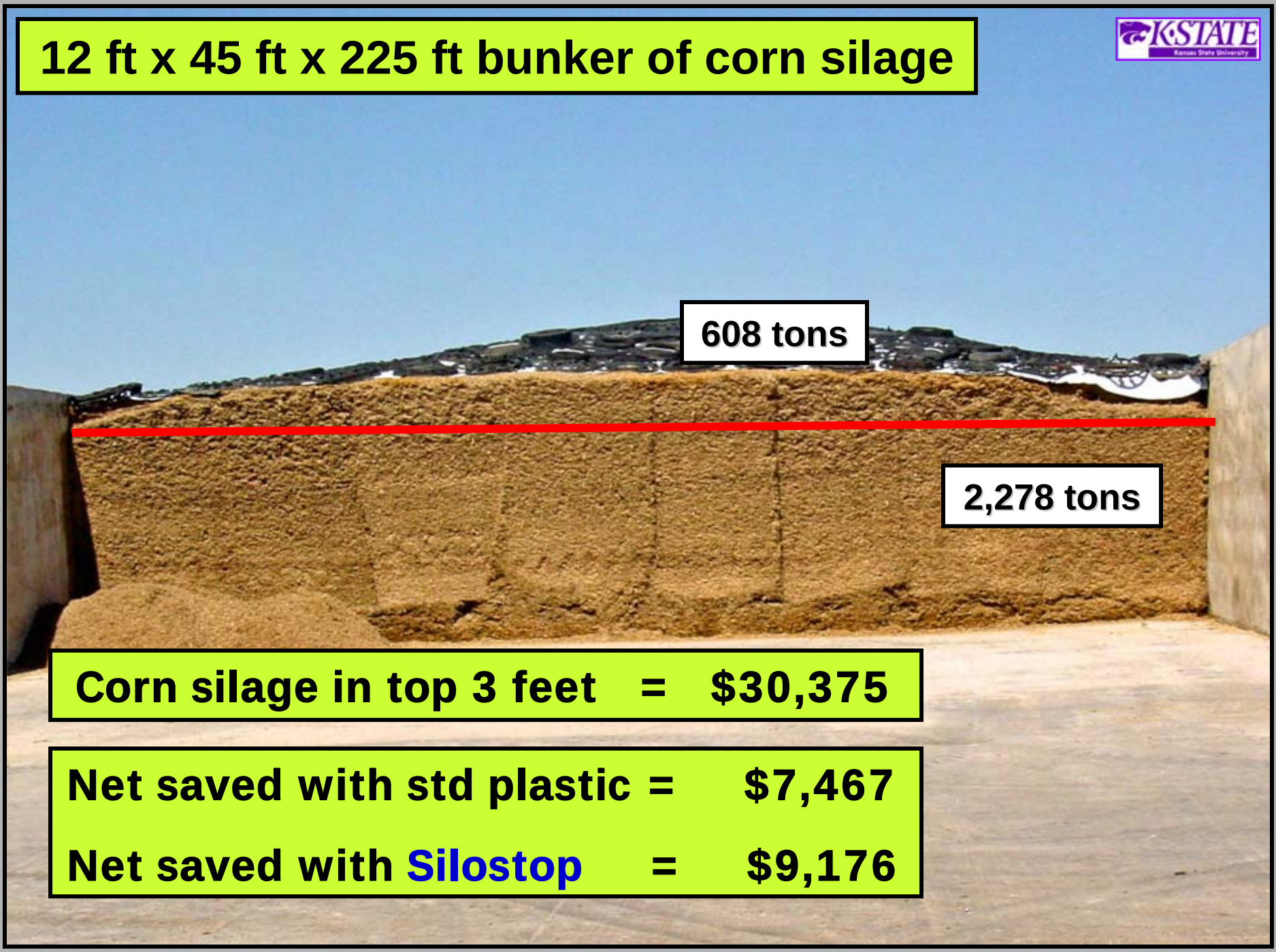
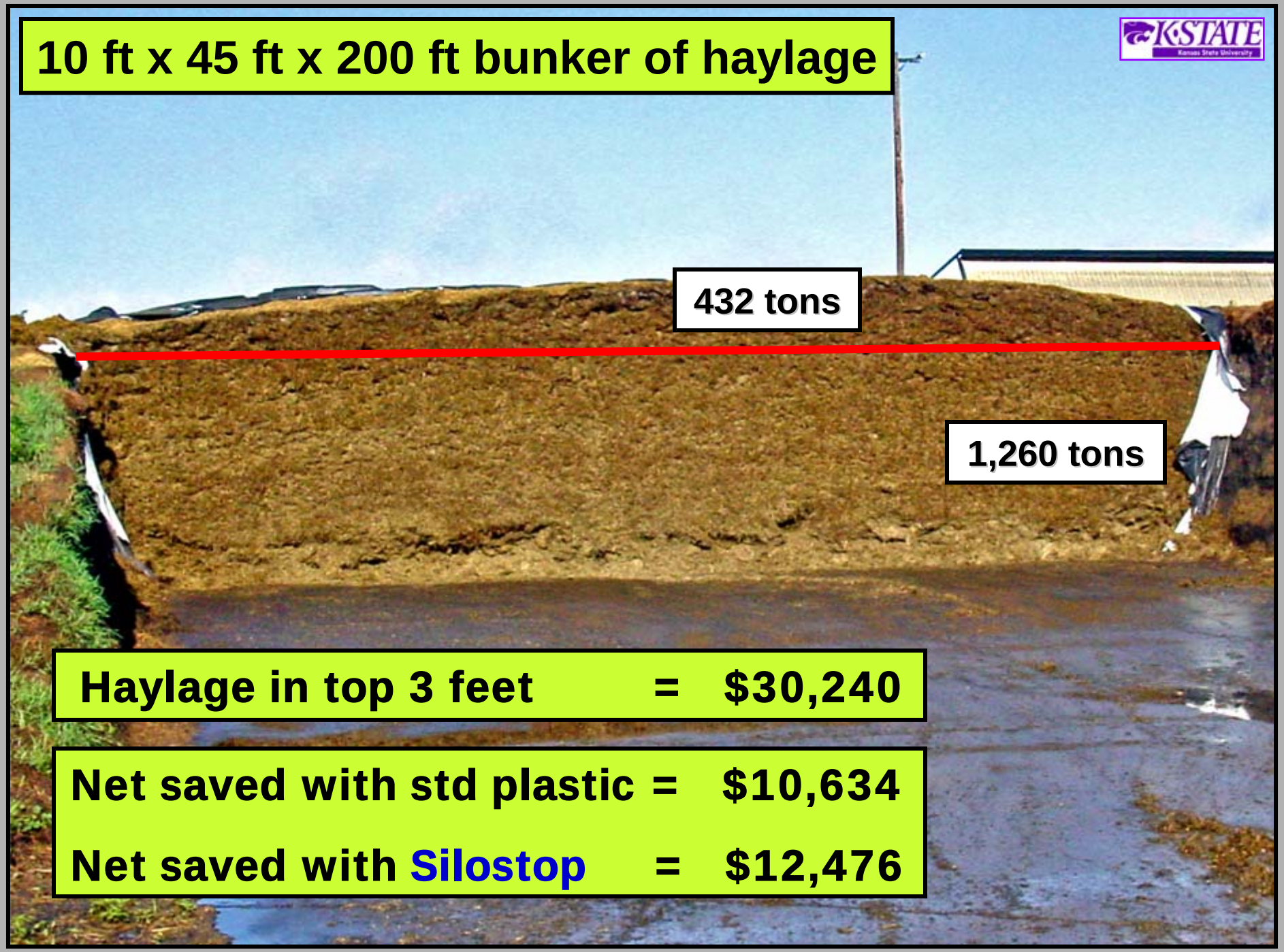
12 ft x 45 ft x 225 ft bunker of corn silage



Corn silage in top 3 feet = $30,375

Net saved with std plastic = $7,467

Net saved with Silostop = $9,176


10 ft x 45 ft x 200 ft bunker of haylage
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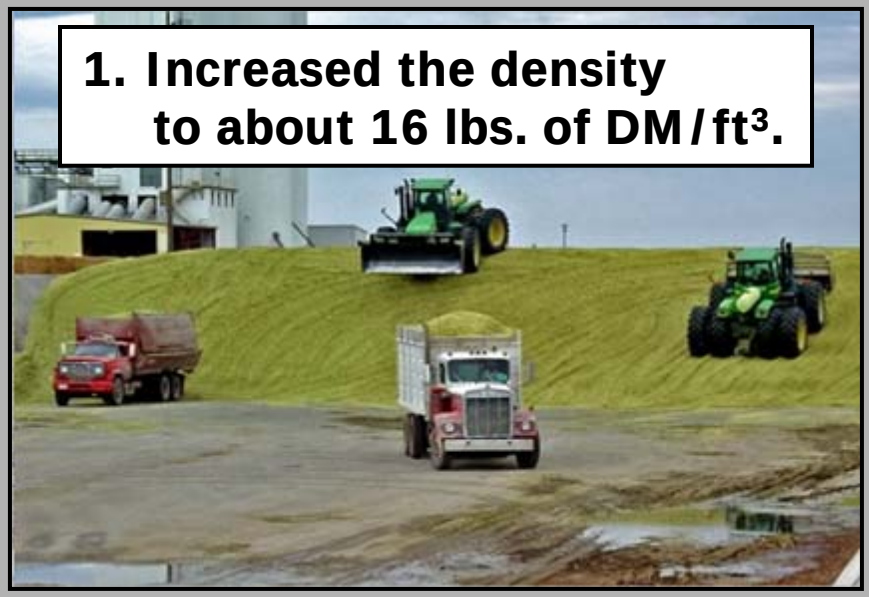
432 tons
1,260 tons
Haylage in top 3 feet = $30,240
Net saved with std plastic = $10,634
Net saved with Silostop = $12,476

Feedlot in Kersey, CO

3-step solution: September 2006



Spreadsheet Calculations of the Average Silage Densities in a Bunker of Corn Silage on the *Case Study Feedlot*.[1]

Component	Actual: 2005 corn silage	Predicted: 2006 corn silage
Bunker silo wall height, ft (0 for silage pile)	18	18
Bunker silo maximum silage height, ft	7	7
Forage delivery rate to bunker, fresh tons/hr	250	250
Forage DM content, %	0.333	0.333
Est. forage packing layer thickness, inches	7	5
Tractor # 1	50,000 (75)[2]	50,000 (75)
Tractor # 2	50,000 (80) →	50,000 (85)
Tractor # 3		40,000 (90)

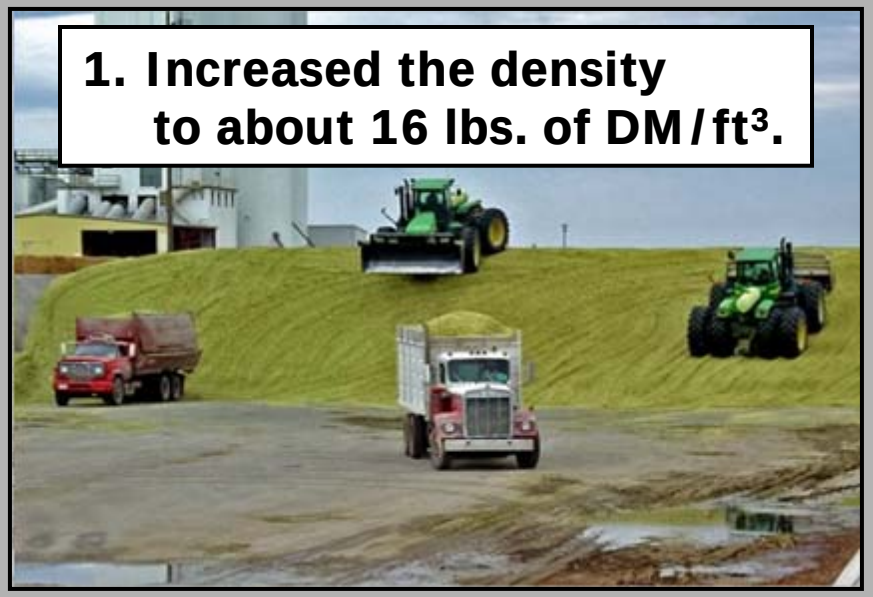
Estimated average DM density, lbs/ft^3 **16.6**

[1] Values above the line are user inputs. [2] Estimated packing time as % of filling time.

Feedlot in Kersey, CO

3-step solution September 2006

TEAM meeting on
July 12, 2006



1. Increased the density to about 16 lbs. of DM/ft^3.

June 2007

3. Used double plastic and applied sufficient, uniform weight.

2. Prepared the proper surface to seal.

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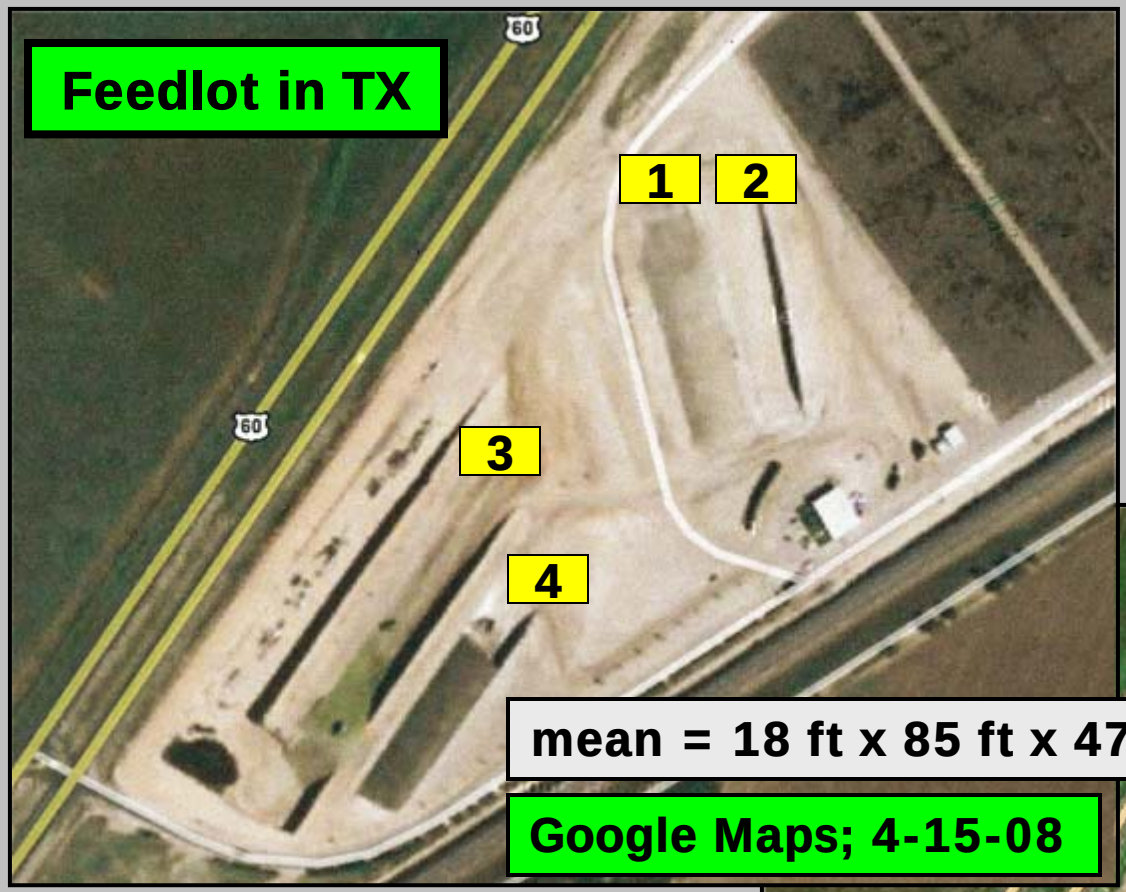
& Associates

Feedlot in Kersey, CO

3-step solution in September 2006

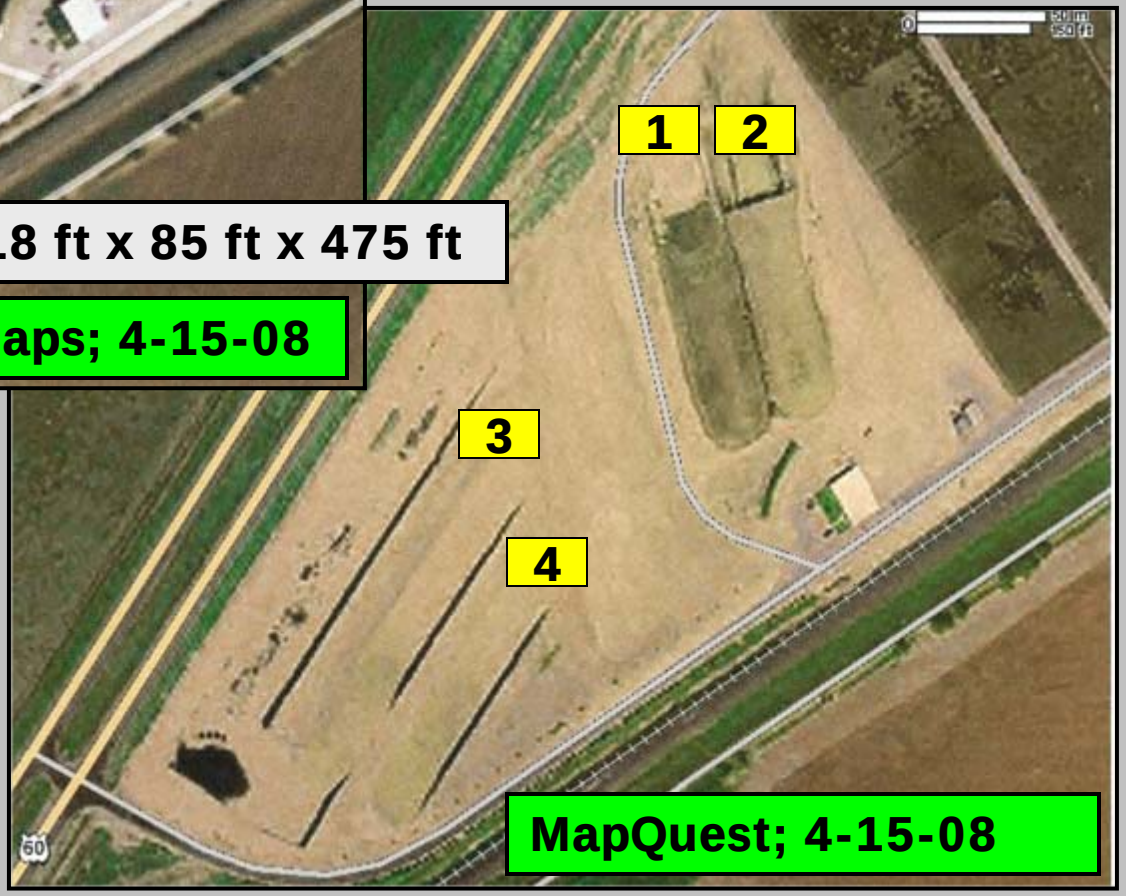
$55/ton

= $119,672



mean = 18 ft x 85 ft x 475 ft

Google Maps; 4-15-08



MapQuest; 4-15-08

Feedlot in TX

$50 / ton

$39,870 **x 4 bunkers** **=** **$159,480**

Avoiding Common Silage Pitfalls

1. Achieve a higher silage DM density
2. Apply the best seal
3. Manage the delivery

Keith Bolsen Ph.D.
& Associates

Did someone on your team check ***Silage Visual Quality*** this morning?

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Beautiful!!

“How do your feeders decide which corn silage to load first?”

“Keith, I’ll be brutally honest, we just chase the avalanches & loose piles every morning.”

Delivery: Manage the Face

- ✓ Maintain a rapid progression through the silage during the entire feedout period.
- ✓ The face should be a smooth surface, which is perpendicular to the floor of a bunker or pile.
- ✓ Proper unloading technique includes shaving silage down the feedout face and never 'digging' the bucket into the bottom of the silage face.
- ✓ Undercutting creates an overhang of silage that can loosen and tumble to the floor.
- ✓ Remove 9 to 12 inches per day in cold weather months; 12 to 18 inches, in warm months.
- ✓ Minimize the time corn silage sits in the commodity area before it is added to the ration.
- ✓ It might be necessary to remove silage from a bunker or pile and move it the commodity area two times per day.
- ✓ Consider using a silage facer as an alternative to a front-end loader.

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Surface-spoilage

Feed it?
or
Pitch it?

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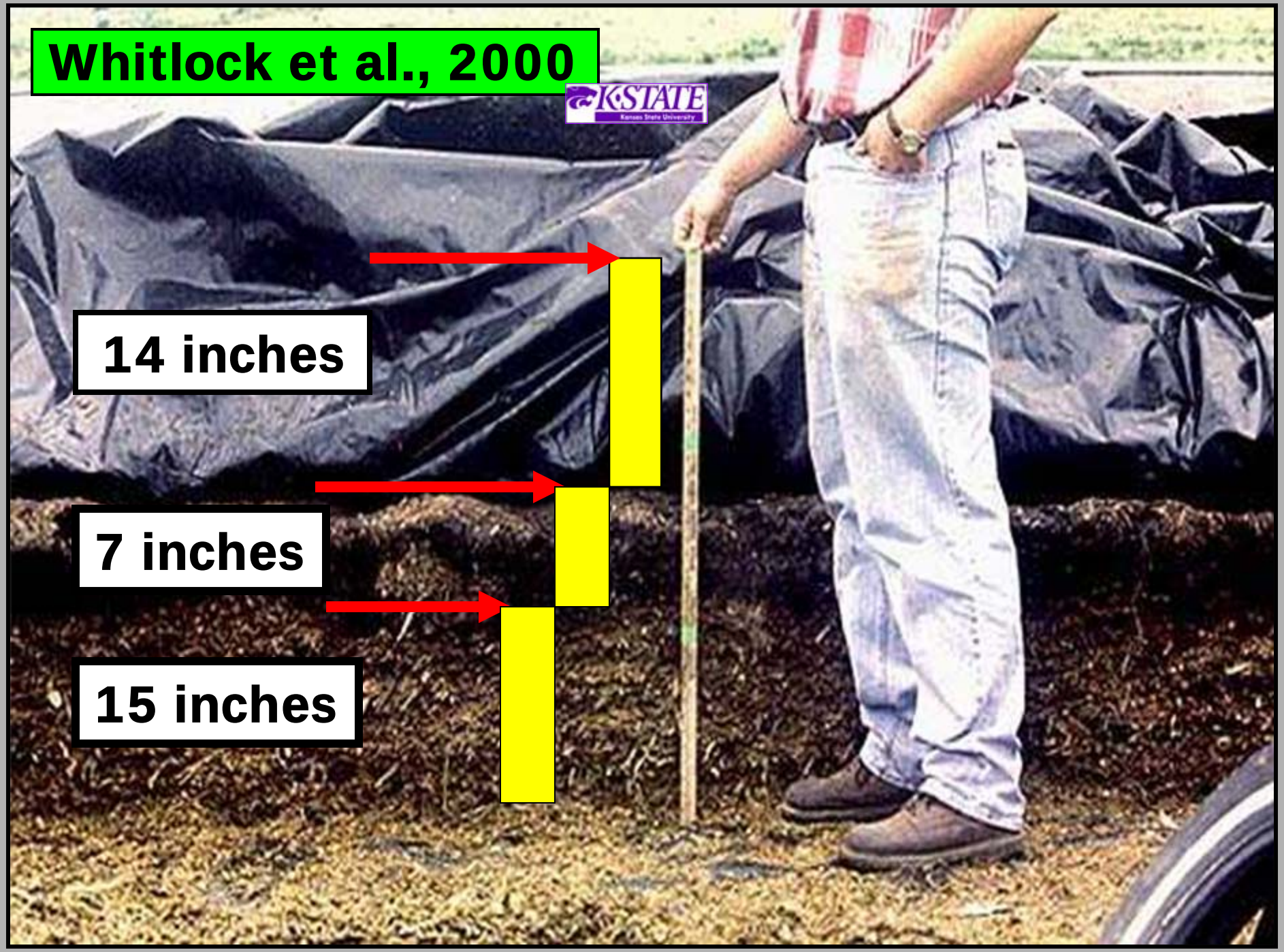

Whitlock et al., 2000
K-STATE
Kansas State University
14 inches
7 inches
15 inches

Surface-spoiled Corn Silage Research at Kansas State

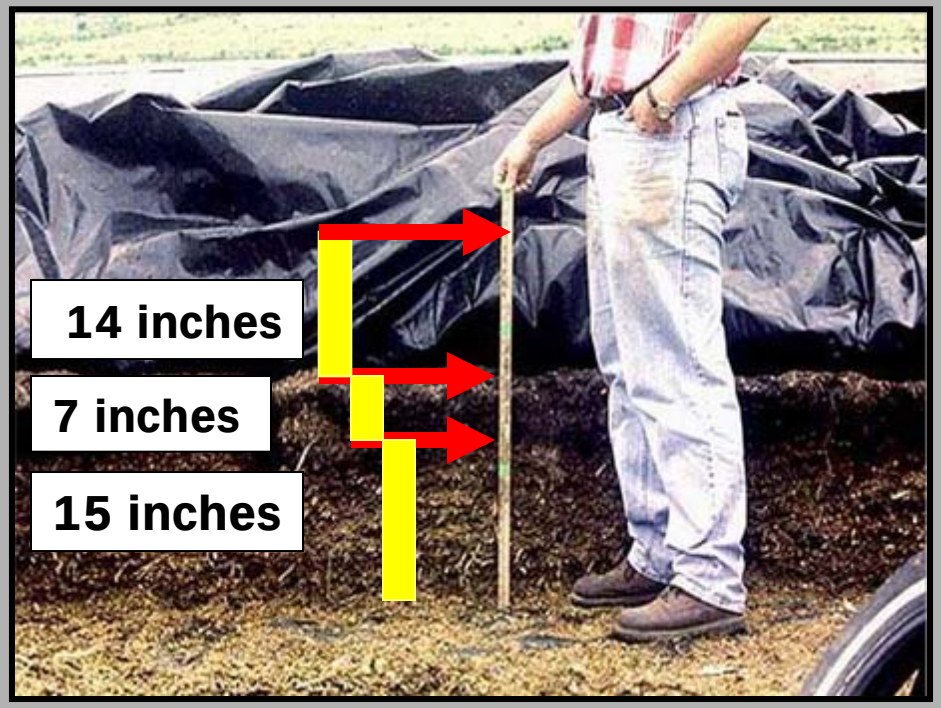
'Slime' in the ration, % on a DM basis:

0, 5.4. 10.7, and 16.0

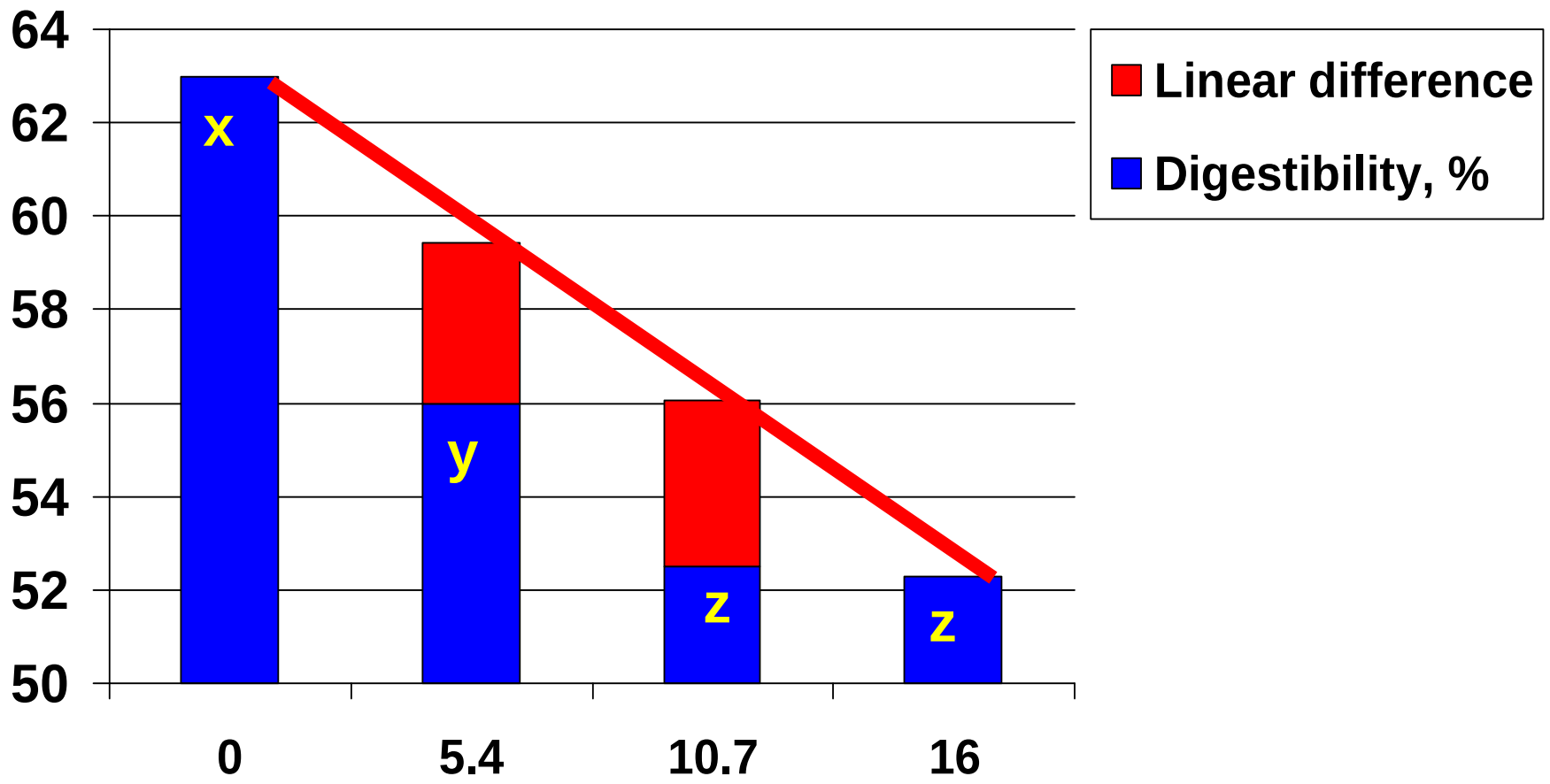
Whitlock et al., 2000

Key results

- ✓ Depressed DM intake.
- ✓ Destroyed the forage mat in the rumen.
- ✓ Reduced fiber digestibility dramatically.



NDF Digestibility



Whitlock et al., 2000

So … How much was ‘feeding spoilage’ costing this growing operation?

Economic Impact of *Creating* and *Feeding* Surface-spoiled Corn Silage to Growing Cattle.[1]

Item	Ration and silage management combinations				
	A	B	C	D	E
'Slime' in the ration, % (DM basis)	0	2.7	2.7	→	5.4
Corn silage NEg , Mcal per lb of DM	0.45	0.45	0.425	→	0.40
DM recovery, % of the crop ensiled	87.5	87.5	82.5	→	77.5
DM intake, lbs per day	17.0	16.5	16.5	→	16.0
ADG, lbs	2.25	2.12	2.00		1.75
DM per lb of gain, lbs	7.55	7.80	8.25		9.15
Silage per lb of gain, lbs as-fed[2]	19.8	20.5	21.6		24.0
Gain per ton of crop ensiled, lbs	88.2	85.4	76.2		64.4
Lost gain per ton of crop ensiled, lbs	---	2.8	12.0		23.8
Value of gain lost per ton of crop ensiled, $	---	2.94	12.60		24.99

[1] Assumes an average cattle weight of 650 lbs and a live weight price of $1.05 per pound.
[2] Assumes silage is 87.5% of the ration (DM basis) and the silage is 33.3% DM.

How much does feeding surface-spoiled corn silage cost dairy producers?

- ✓ 0.3 to 2.5 lbs less milk /cow/day.[1,2]
- ✓ $15 to $120 less milk /cow/year ($16 cwt).

---

[1] Assumes that 1 percentage unit of NDF digestibility equals 0.55 lbs of milk /cow/day.

[2] Assumes that 1% surface-spoilage in the ration decreases NDF digestibility by 1.3 percentage units.

Avoiding Common Silage Pitfalls

5. Be Safe

Keith Bolsen Ph.D. & Associates

Keith Bolsen[1] and Ruthie Bolsen[2]

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There are far too many “over-filled” bunker silos and drive-over piles that are NOT SAFE!!

Hybrids:

2 bunker silos + 1 pile

Dangerous & inefficient

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At 3:45 pm on December 3, 1999, 6 tons of haylage in a bunker silo collapsed on Nick Schriner of Athens, Wisconsin. Schriner was rescued in a matter of minutes, but he suffered a C6 spinal cord injury. Nick is a quadriplegic for life.

Successful Farming, September 2000

“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 bunker silo and face management was text book.”

Personal communication from a feedlot nutritionist; July 2008.

Important Quotes … "We have nothing to lose by practicing safety; but we have everything to lose by not practicing it." Dennis Murphy, Extension Safety Specialist, Penn State U.

Major Hazards:

- ✓ **Fall from height.**
- ✓ **Run-over by machinery.**
- ✓ **Tractor roll-over.**
- ✓ **Entangled in machinery.**
- ✓ **Crushed by an avalanche.**
- ✓ **Complacency.**

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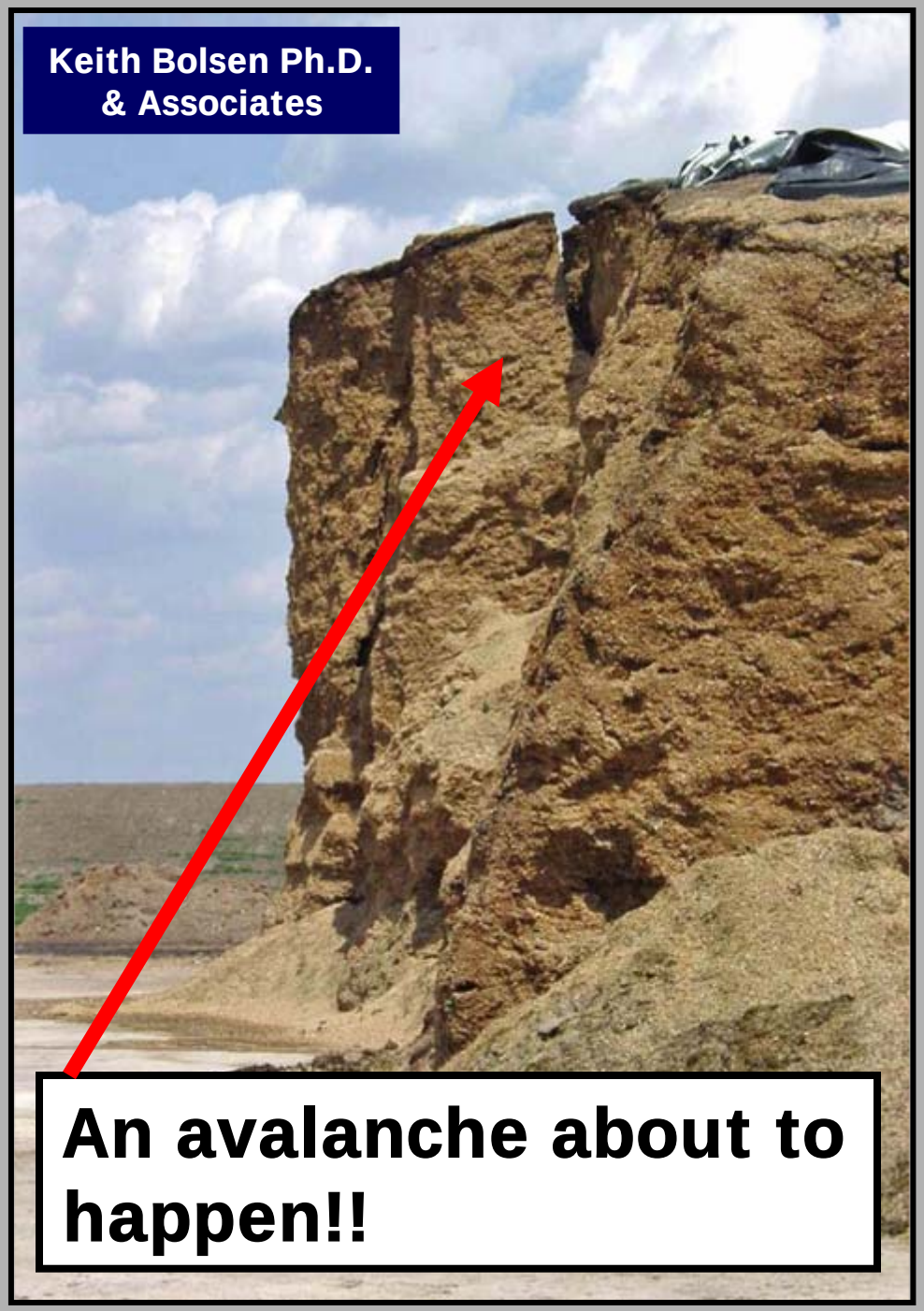
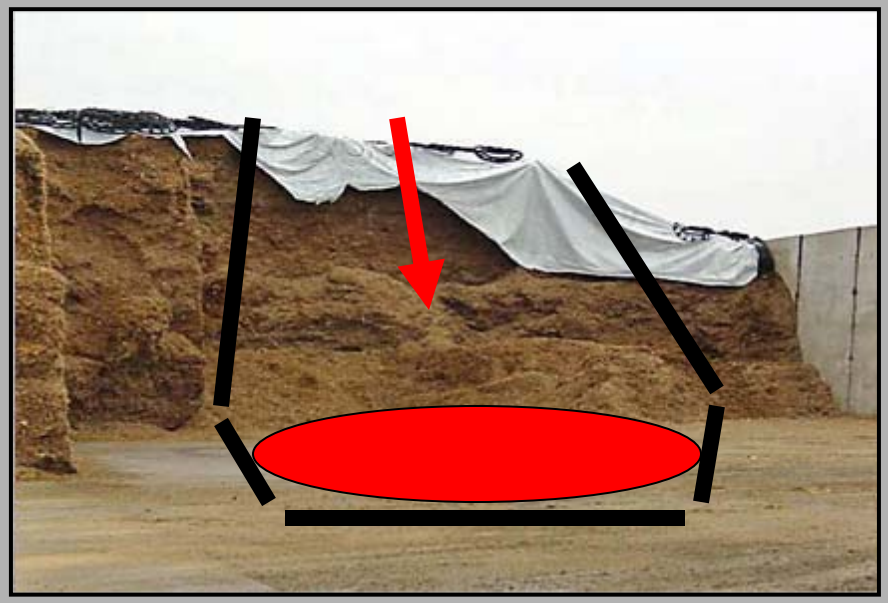
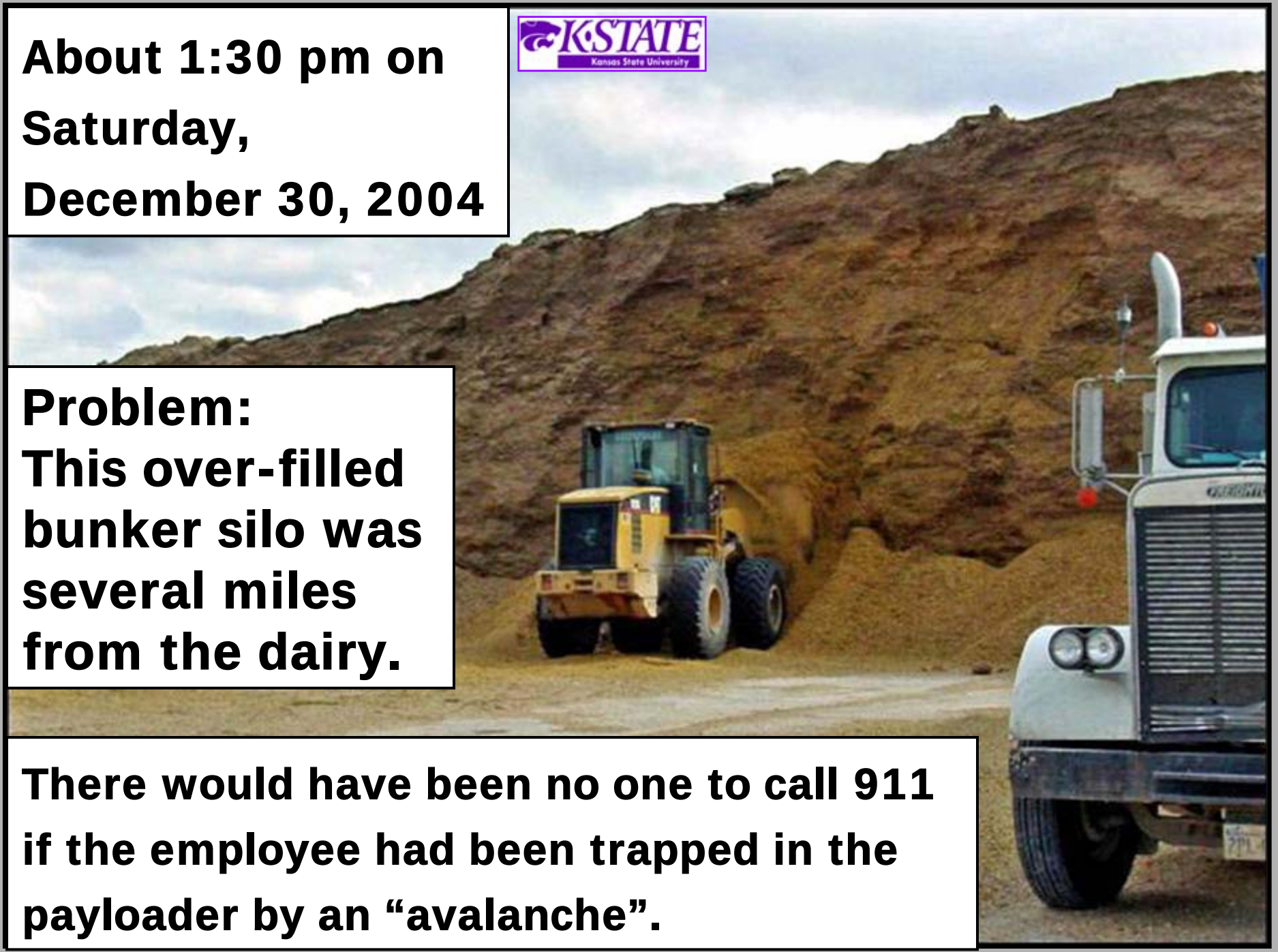


An avalanche about to happen!!



About 1:30 pm on Saturday, December 30, 2004



Problem:
This over-filled bunker silo was several miles from the dairy.

There would have been no one to call 911 if the employee had been trapped in the payloader by an “avalanche”.

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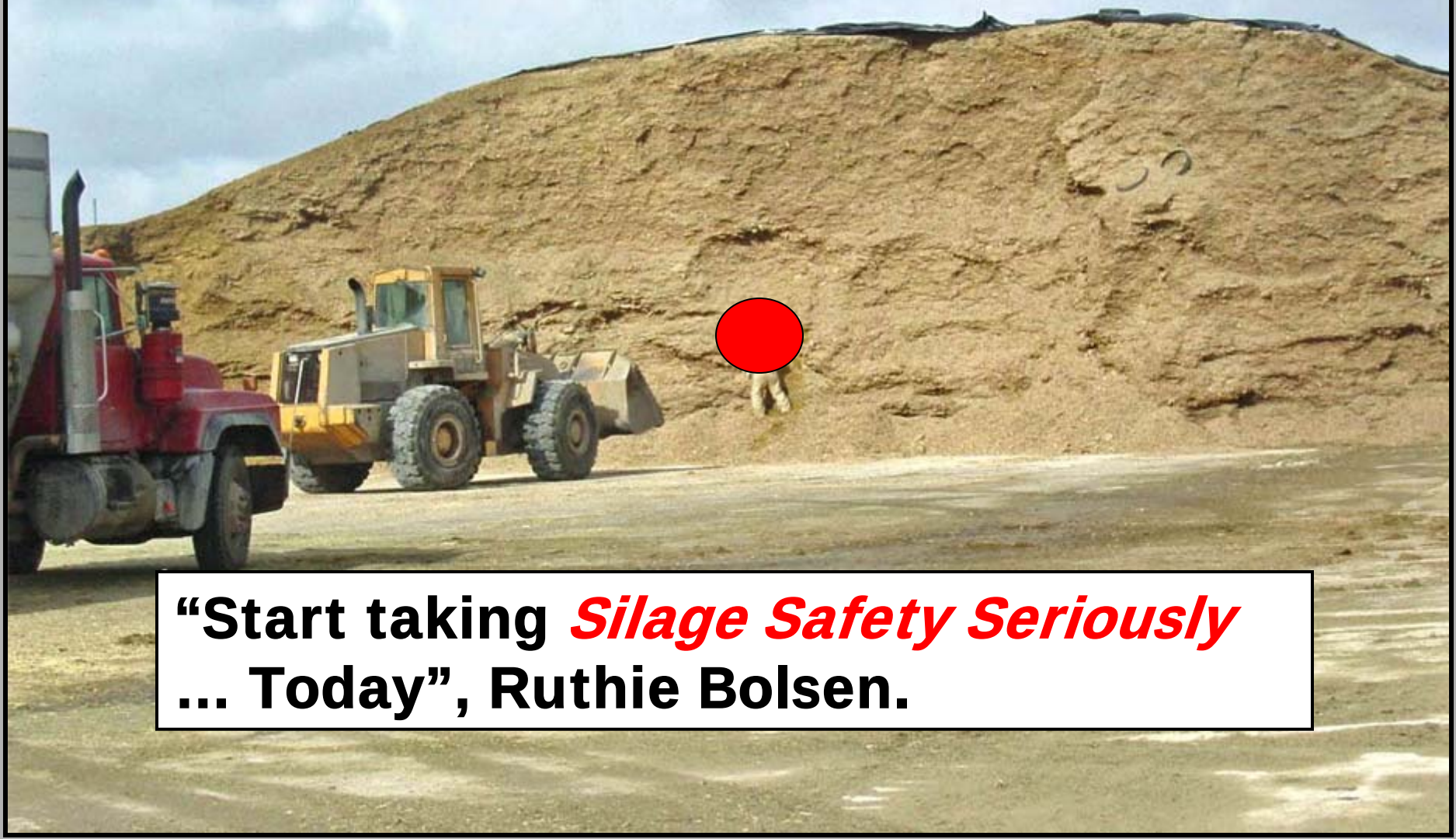
Important Quotes ...



"Start taking *Silage Safety Seriously* ... Today", Ruthie Bolsen.

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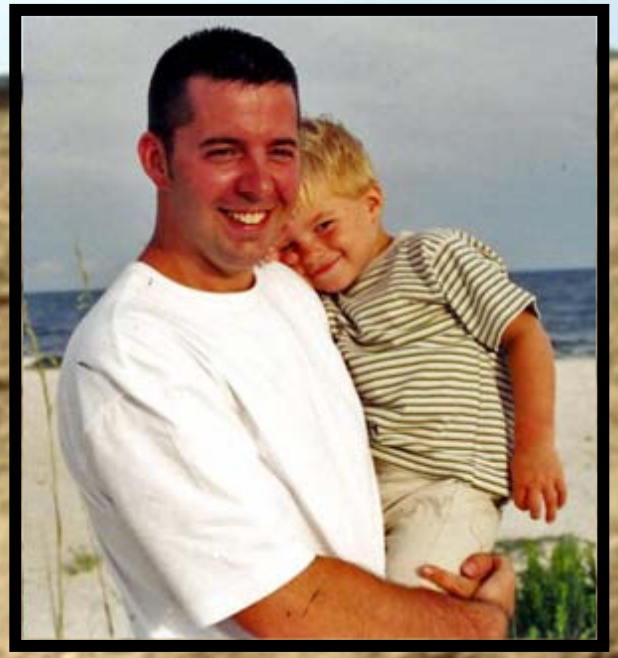
Footnote ...



Ruthie's son, Kreg Morris, died on 9-30-01 in an auto accident that did NOT HAVE TO HAPPEN. Kreg was a 32-year attorney with a 3-year old son at the time of his accident.

Do you discuss bunker silo and drive-over pile 'safety issues' with your TEAM?

It's really not about shrink loss, feed conversion, cost of gain, close outs, or milk over feed costs.

It's about sending all dairy employees home to their families SAFE … EVERYDAY!!

THANK YOU!!

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Joey

Smacky

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