

# Managing Forage for Single Digit Shrink Loss in Bunker Silos and Drive-over Piles

**2012 Corn Silage and Forage Field Day  
Citra, FL  
May 24, 2012**



**Keith Bolsen Ph.D.  
& Associates**



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**[www.ksre.ksu.edu/pr\\_silage](http://www.ksre.ksu.edu/pr_silage) [ruthbolsen@me.com](mailto:ruthbolsen@me.com)**



**Dairy / Feedlot**

**Keith Bolsen Ph.D.  
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**Silage  
Triangle**

**Crop Grower**

**Silage Contractor**

# Corn Silage Production (NASS 2012)

**2007**

**2008**

**2009**

**2010**

**2011**

----- Million tons per year -----

**106.3**

**111.6**

**108.2**

**107.3**

**108.9**

**5-yr avg. = 108.5**

**FL**

**0.63**

**0.51**

**0.54**

**0.45**

**0.54**

**5-yr avg. = 0.53 (33rd)**

**GA**

**0.72**

**0.81**

**0.51**

**0.72**

**0.95**

**5-yr avg. = 0.74 (30th)**



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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.

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.

**Reported cattle performance and sources of loss in an 80 ton capacity tower silos. Seven percent of the whole-plant corn ensiled vs. weight of the silage removed could not be accounted for, so the authors explained it as a loss by evaporation.**

**77% of the forage ensiled was 'sound' and available for feeding'. Shorter chop lengths of 1/2-inch compared to 1-inch resulted in 'closer packs' and cattle 'ate it up cleaner'.**



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# 'SHRINK' LOSS is TOO HIGH, TOO OFTEN!



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# What is the “Market Value” of Corn Silage based just on Shrink Loss?

- **\$62.50 / ton ÷ 95.0% = \$65.79**
- **\$62.50 / ton ÷ 90.0% = \$69.44**
- **\$62.50 / ton ÷ 85.0% = \$73.53**
- **\$62.50 / ton ÷ 80.0% = \$78.12**
- **\$62.50 / ton ÷ 75.0% = \$83.33**
- **\$62.50 / ton ÷ 70.0% = \$89.29**

Forage In vs. Silage Out

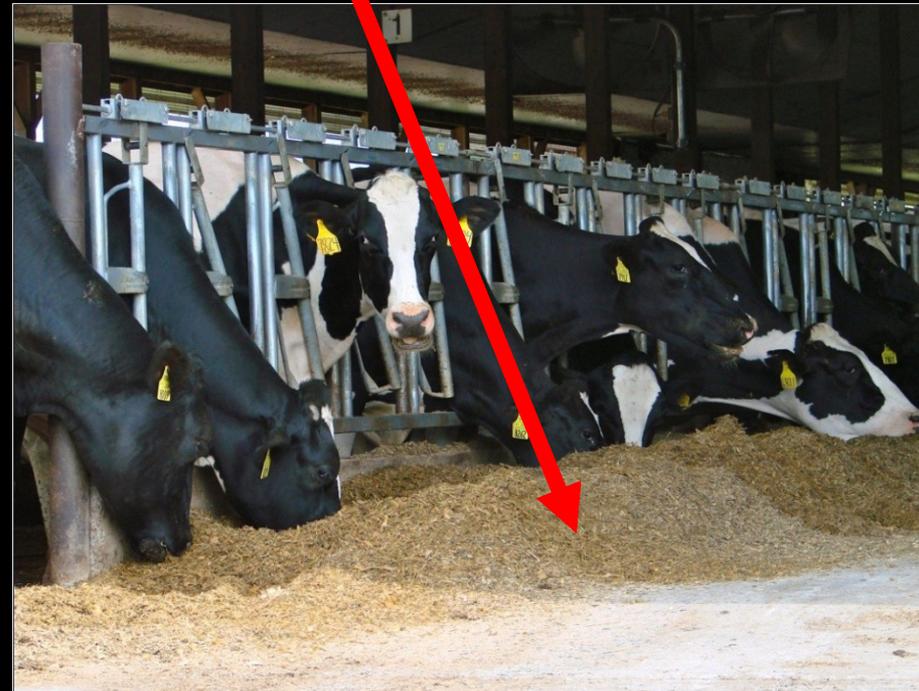
# How much is Shrink Loss going to cost our Corn Silage Industry in 2011-2012?

About \$1.29 billion!

Could be only 600 million!



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## Basic Principles of Silage

### Four Phases:

**1. AEROBIC**

**2. FERMENTATION**

**3. STORAGE**

**4. FEEDOUT**



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# What can we learn from these PRODUCERS?

## They had a MEETING!



# Three Important Silage-making Goals

- 1. Inoculate at the forage chopper**
- 2. Reach a higher silage density**
- 3. Apply the best seal**



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# Economics of Inoculated Corn Silage for Dairy Cows. <sup>a</sup>

1. 80 lbs of milk/cow/day
2. 53 lb DMI/cow/day\*
3. Milk price = **\$16** per cwt

<sup>a</sup> 48 lbs of corn silage





## Bottom Line

## Corn Silage

**Inoculant cost/cow/day**

**2.1¢**

**↑ net income/cow/day**

**15.6¢**

**↑ net income/cow/year**

**\$47.54**



# Four Bad Ideas for Application!!



# Three Important Silage-making Goals

1. Inoculate at the forage chopper
2. Reach a higher silage density
3. Apply the best seal



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

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

**Avg. = 14.5**

**Targets:  
16 lbs of DM  
48 lbs of fresh weight**

# Case Study Dairy

7,000-ton pile of corn silage the 1<sup>st</sup> yr

11.5 lbs of DM/ft<sup>3</sup> = 22.5% shrink 1<sup>st</sup> yr corn silage @ **\$60/ton**



# Spreadsheet Calculations of the Average Silage Densities in Drive-over Piles of Corn Silage at a *Case Study Dairy*.<sup>1,2</sup>

Component	Keith Bolsen Ph.D. & Associates	KSTATE Kansas State University	A Bruno Rimini Brand SILOSTOP	Actual: 1 <sup>st</sup> yr. corn silage	Predicted: 2 <sup>nd</sup> yr. 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) <sup>3</sup>	35,000 (80) <sup>3</sup>
Tractor #2				0	35,000 (85) <sup>3</sup>
<hr/> <hr/>					
Estimated DM density, lbs/ft <sup>3</sup>				11.4	15.6
Estimated bulk density, lbs/ft <sup>3</sup>				35.7	45.8

<sup>1</sup> Values in above the double line are user inputs.

<sup>2</sup> Adapted from Holmes and Muck (2007).

<sup>3</sup> Estimated packing time as a percent of filling time is shown in parenthesis.

**11.4 lbs of DM/ft<sup>3</sup> = 22.5% shrink in 1<sup>st</sup> year.**

**15.8 lbs of DM/ft<sup>3</sup> = 15.0% shrink target in 2<sup>nd</sup> year.**

**An est. 525 tons of silage “saved” x \$60/ton = \$31,500**

**Cost to the dairy: 2<sup>nd</sup> pack tractor (\$1.75/ton) = \$12,250**

**Estimated net benefit to the dairy: \$19,250 (market value)**



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# Does Your TEAM have a Michelangelo?



A Bruno Rimini Brand  
**SILOSTOP**

**KSTATE**  
Kansas State University

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# Achieving higher DM densities ...

- ↓ forage delivery rate (not likely to happen).
- ↑ packing tractor weight (yes, always possible).
- ↑ number of tractors (yes, usually possible).
- ↓ forage layer thickness (not always possible).

Fill silos to greater depths (not a good idea).

Pack longer at the end of the day (waste of time  
& diesel fuel).



# Three Important Silage-making Goals

1. Inoculate at the forage chopper
2. Reach a higher silage density
3. Apply the best seal

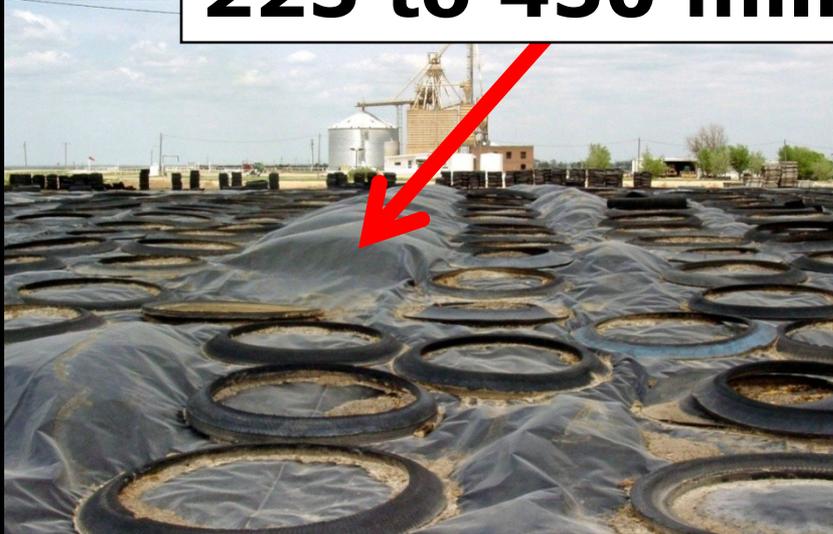


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# Poorly SEALED bunker silos and drive-over piles are a HUGE problem!!



**225 to 450 million dollars per year**



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# Research with **Silostop**



A Bruno Rimini Brand  
**SILOSTOP**



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# Oxygen Transmission Rate (OTR)

<b>Sample</b>	<b>Thickness, mil</b>	<b>OTR ASTM D3985 100% O<sub>2</sub> cm<sup>3</sup>/m<sup>2</sup>/24 h</b>
<b>Silostop</b>	<b>1.8</b>	<b>30</b>
<b>Regular silage cover</b>	<b>5.0</b>	<b>1,811</b>
<b>Cover B</b>	<b>7.0</b>	<b>710</b>
<b>Cover C</b>	<b>1.6</b>	<b>5,293</b>
<b>Cover D</b>	<b>1.6</b>	<b>5,982</b>

Source: School of Packaging, Michigan State University



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



Item	---- Corn silage ----		---- HM corn ----	
	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 <sup>1,2</sup>	34.8	17.8	12.1	6.7
	----- % 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	2.13	1.98

<sup>1</sup> Values are estimated additional spoilage loss of OM, which were calculated from ash content using the equations described by Dickerson et al. (1992a).

<sup>2</sup> Ash content of the pre-ensiled samples was 7.6% for corn silage & 1.8% for HM corn.



# Main Effect of Sealing Treatment

<b><sup>ab</sup> <math>P &lt; 0.05</math></b>	<b>Std. plastic</b>	<b>Silostop</b>
DM, %	23.7 <sup>b</sup>	29.5 <sup>a</sup>
pH, %	4.50 <sup>b</sup>	3.82 <sup>a</sup>
ash, %	3.14 <sup>b</sup>	2.78 <sup>a</sup>
Est. OM loss	<b>24.1</b>	<b>14.0</b>
NDF, %	55.0 <sup>b</sup>	45.2 <sup>a</sup>
Lactic acid, %	1.3 <sup>b</sup>	2.2 <sup>a</sup>
Acetic acid, %	2.8 <sup>b</sup>	4.2 <sup>a</sup>
Butyric acid, %	0.3 <sup>b</sup>	< 0.1 <sup>a</sup>

**Economics of sealing corn silage w/ standard plastic or Silostop in bunker silos with average management practices (Numbers above the red line are user inputs).**

Inputs and calculations	Keith Bolsen Ph.D. & Associates			Bunker1 std. plastic	Bunker 2 Silostop
Silage value, \$ per ton 'as-fed'				60.00	60.00
Density of silage in top 3 ft, lb 'as-fed' per ft <sup>3</sup>				36	36
Silage density below top 3 ft, lb per ft <sup>3</sup>				44	44
Bunker/pile depth, ft				14	14
Bunker/pile width, ft				60	60
Bunker/pile length, ft				240	240
Silage lost in original top 3 feet % of crop ensiled <sup>2</sup>				30.0	15.0
Silage lost below original top 3 ft, % of crop ensiled				12.0	12.0
Cost of covering sheets, ¢ per sq. ft				4.5	12.5
Bunker/pile capacity, tons				4,262	4,262
Total value of silage in the bunker/pile, \$				255,744	255,744
Silage in the original top 3 ft, tons				778	778
Silage below the original top 3 ft, tons				3,484	3,484
Total silage lost in bunker/pile, % of the crop ensiled				15.29	12.55
Silage saved by sealing, \$				9,331	16,330
Sealing cost, \$				2,250	4,050
Net silage saved by sealing, \$				7,081	12,280
Net benefit from Silostop, \$				---	5,198

1



2



4



3



# Surface-spoilage

## Feed it? or Prevent it?



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# Surface-spoiled Corn Silage Research at Kansas State

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

0, 5.4, 10.7, and 16.0

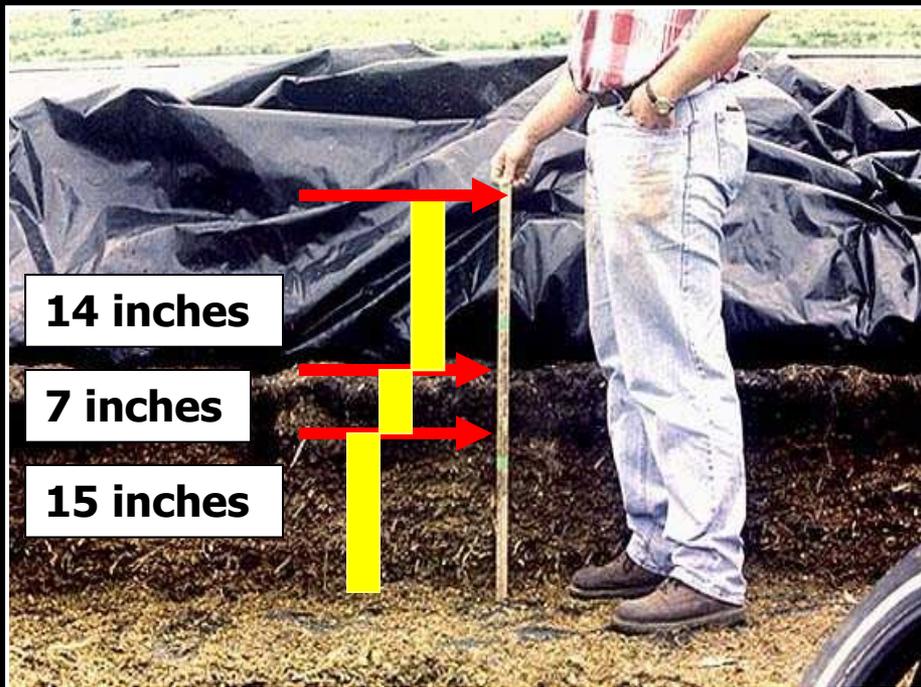
Whitlock et al. (2000)

## Key results

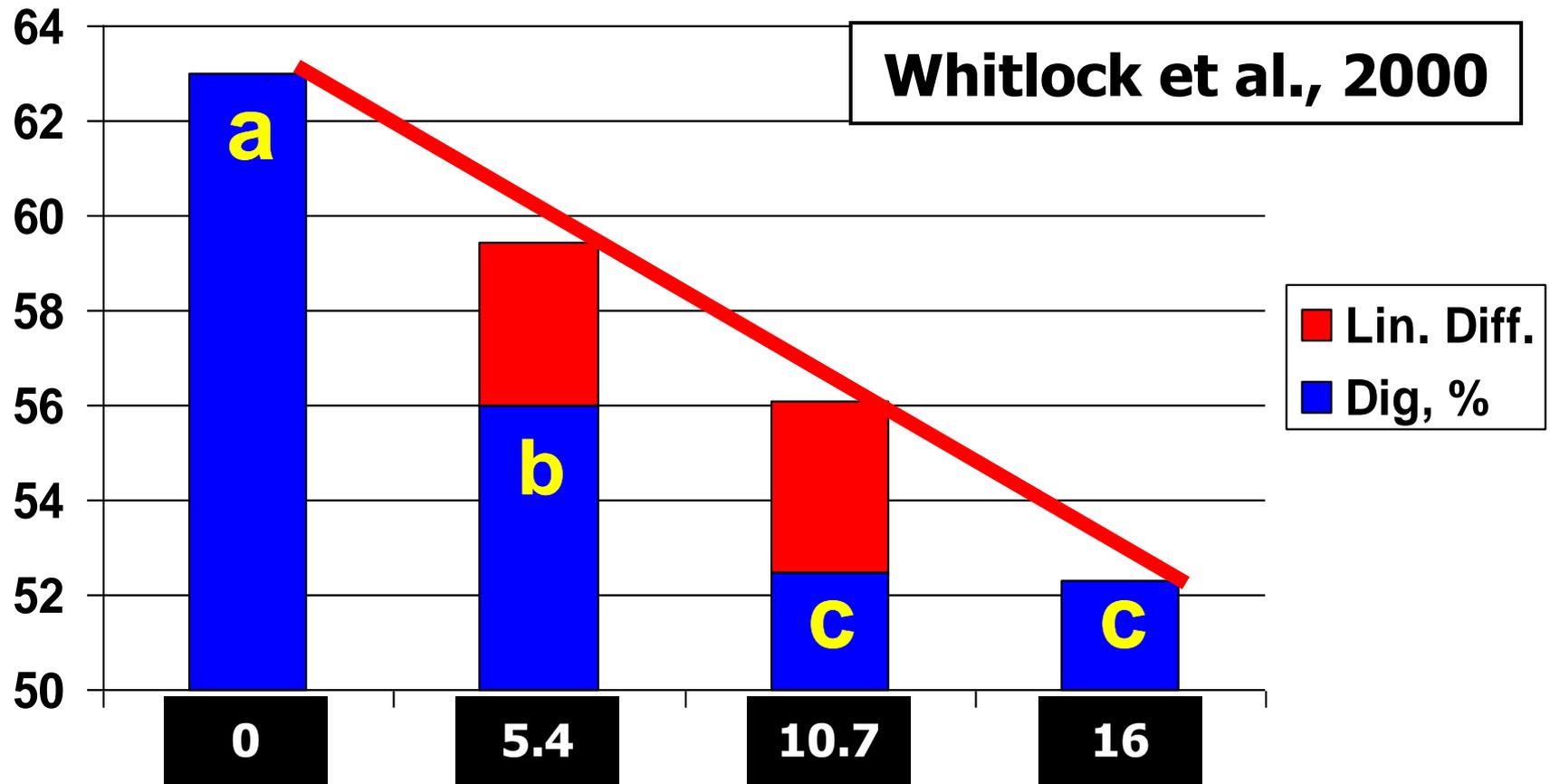
- ✓ Depressed **DM intake**.
- ✓ Destroyed the **forage mat** in the rumen.
- ✓ Reduced **fiber digestibility** dramatically.



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# NDF Digestibility



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

- ✓ **0.3 to 3.0 lbs less milk /cow/day.<sup>1,2</sup>**
- ✓ **\$15 to \$145 less milk /cow/year (\$16 cwt).**

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**<sup>1</sup> Assumes that 1 percentage unit of NDF digestibility equals 0.55 lbs of milk /cow/day.**

**<sup>2</sup> Assumes that 1% surface-spoilage in the ration decreases NDF digestibility by 1.3 percentage units.**

# Pitch the Spoilage?

# No ... It is just too Dangerous!

# But ... It can be Prevented!



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# Safety Issues in Bunker Silos and Drive-over Piles

**THINK SAFETY FIRST ...**

**“We have nothing to lose by practicing safety; but we have everything to lose by not practicing it.”**

**Dennis Murphy, Ext. Safety Specialist, The Pennsylvania State University**

## Major Hazards:

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



**An 11-year old boy died from injuries suffered after a feed pile collapsed on top of him at a Claremont farm (WMUR TV, 2010).**

**Andy Wheeler had previously been listed in critical condition at Dartmouth-Hitchcock Medical Center. Police said it took as long as 20 minutes to find and free Wheeler from the feed pile after the accident Tuesday.**

**Police said the boy was on vacation from Maple Avenue School which is why he was hanging out at the MacGlaflin Farm, where his father works. He was riding his bike near a silage crib, where livestock feed is stored, police said.**

**“The boy was in a silage crib where there was a large pile of silage, and that overhang collapsed,” said Police Chief Alexander Scott. Scott said it took some time for anyone to realize there was a problem. “It is probably a pile close to 25 feet high” he said. School officials said they are preparing for questions from students when they return from spring break.**

**WMUR TV. Claremont, NH. Web site accessed August 21, 2010.**

# Man dies in farm accident

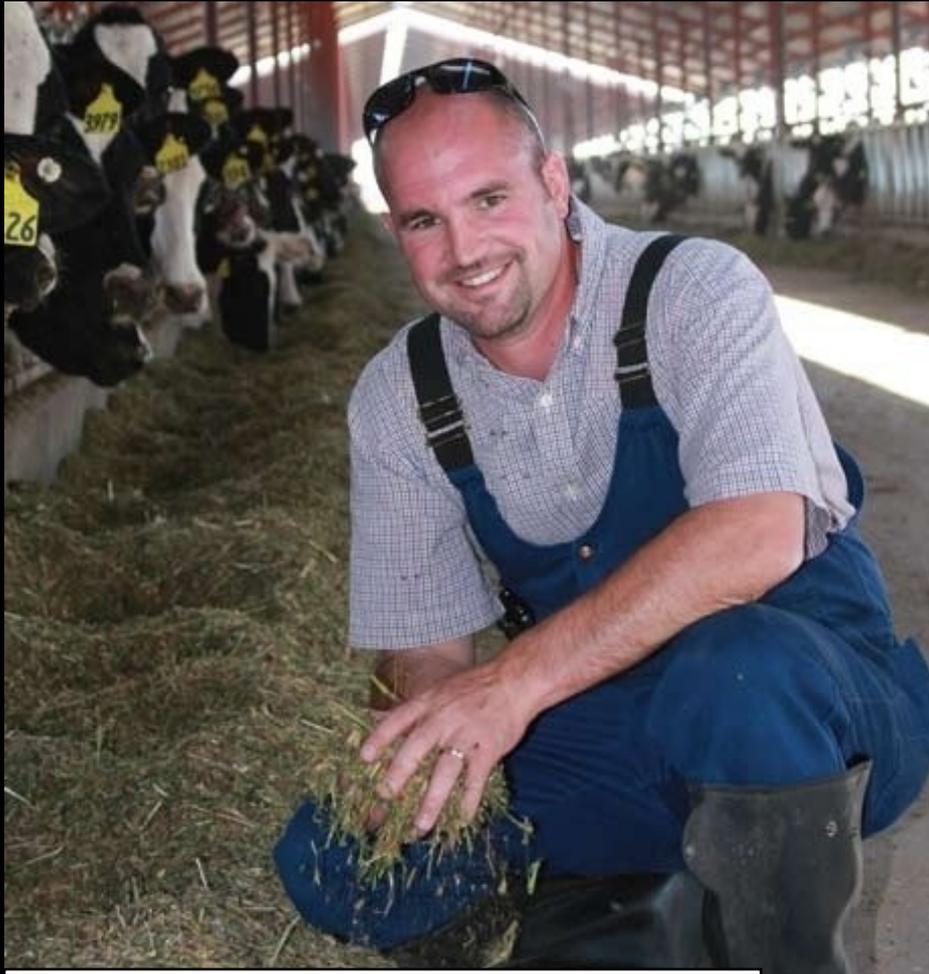
**The Express**  
**Lock Haven, PA**  
**February 9, 2007**

LOGANTON — Sugar Valley Volunteer Fire Company responded to a farm accident Tuesday evening in Greene Township after Kenneth R. Hettinger, 63, of Rebersburg, became trapped in approximately three tons of silage.

Fire personnel said Hettinger was removed from the silage by farm personnel.

Sugar Valley Fire company volunteers attempted to resuscitate Hettinger but were unsuccessful, and he was pronounced dead at the scene by Clinton County Coroner Donald G. Walker.

# February 2010 | Hay & Forage Grower



**Photo: by Hay and Forage**

## **Surviving A Silage *Avalanche***

**By Fae Holin,  
Managing Editor**



**Photo: by Doug DeGroff**

## Important Quotes ...

**“Start taking Silage Safety Seriously ... Today”, Ruthie Bolsen.**



## **Take home message ...**

**It's really not about shrink loss, feed conversion, cost of gain, a close out, or milk over feed cost.**

**It's about sending everyone in your silage program home to their family safe ... EVERYDAY”.**

# Thank You!!



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