



## Better Bagged Silage: What's Important??

Penn State Dairy Nutrition Workshop  
Mycogen Seeds Pre-conference Symposium

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[www.oznet.ksu.edu/pr\\_silage](http://www.oznet.ksu.edu/pr_silage)      [ruthbolsen@austin.rr.com](mailto:ruthbolsen@austin.rr.com)




## 1971 to 2003 ...





## June 7, 2003 ...



So many silage pits ...  
so little time !!




## KSU Silage Home page




[http://www.oznet.ksu.edu/pr\\_silage](http://www.oznet.ksu.edu/pr_silage)


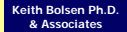
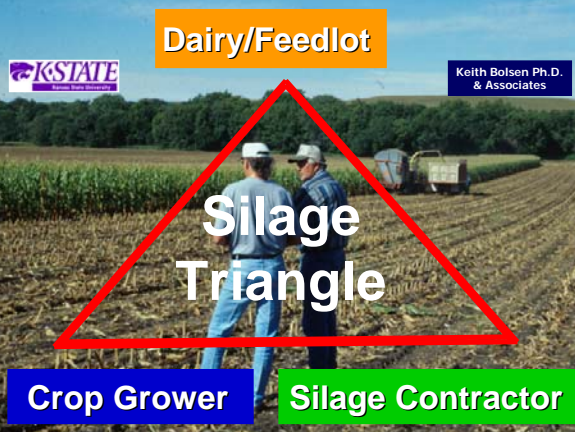
- K-State Silage Team Members
- 1972-2006 MS and PhD Graduates under Keith Bolsen
- Recent Articles and Presentations by the KSU Silage Team
- Silage Team
- Silage Basics
- Silage Team Alumni
- Silage-L
- Publications
- Links
- Basic Principles of Silage
- Instructions to join the listserv Silage-L and links to the archives
- Links to other university and commercial forage websites



Lovington, Illinois 1954



Bement, Illinois 1977


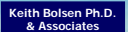




Dairy/Feedlot

Crop Grower

Silage Contractor

Silage Triangle

**Better silage ... its not about playing the "blame game"!!**

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**Dairy/Feedlot**

**Crop Grower** → **Silage Contractor**

**Better Silage ...**

- ✓ Every Crop
- ✓ Every Time

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**Silage Technology 730**  
Keith K. Bolsen & M. Estela Uriarte

"Silage Fermentation"  
By P. McDonald (1980)

"Efficient Silage Systems"  
E. Zimmer (1980)

**Biochemical changes in the ensiling process are from:**

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

McDonald, 1980

**Table 4. DM Losses (% of the ensiled DM) and their causes**

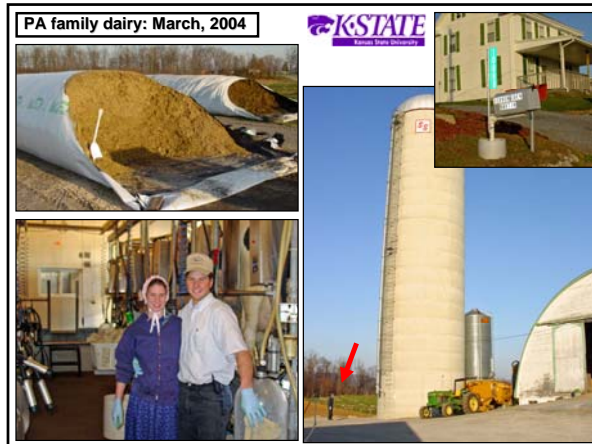
Residual respiration	U	1 - 4	Plant enzymes
Fermentation	U	2 - 6	Microorganisms
Effluent	A	0 - >5	DM content
Secondary fermentation	A	0 - >5	Crop, silo, & DM content
Aerobic spoilage in storage	A/U	1 - >10	Silo, density, sealing, & crop
Aerobic spoilage at feedout	A/U	1 - >10	Unloading technique
<b>TOTAL</b>		<b>5 - &gt;40</b>	

Zimmer, 1980

**The bag silo is one of the fastest growing silo types on dairy farms in the U.S. (Hoard's Dairyman, 2005).**

- Forages are ensiled at approximately the same moisture content as in bunker and pile silos.
- While specialized equipment is needed, bagging machines can be rented to try the system or ...
- Bagging machines can be used to make extra silage when forage yields exceed the capacity of permanent silo structures.

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## COMMON SILAGE PITFALLS ...

- High 'shrink' loss.
- Poor sealing of bunkers/piles.
- Loss of production from surface-spoiled silage.
- Silage safety concerns.
- Poor silage inventory control.
- Clostridial hay-crop silage.

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

## SILAGE PITFALL TO OPPORTUNITY ...

- Reduce 'shrink' loss.
- Provide a more effective seal.
- Prevent the loss of production from surface-spoiled silage.
- Establish silage safety guidelines.
- Improve silage inventory control.
- Eliminate clostridial hay-crop silage.

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## Advantages:

- ✓ Low capital cost silage system.
- ✓ Low initial capital investment cost (with custom bagging!!).
- ✓ Modest labor requirements for filling.
- ✓ Flexible system ... storage capacity can be adjusted to fit crop yields.
- ✓ Recommended forage DM content matches the range for good silage quality.
- ✓ Forage can be easily inventoried by marking bags.

## Advantages:



- ✓ Less likely to have weather damage during filling compared to bunkers & piles.
- ✓ Small "feedout face", particularly in warm weather.
- ✓ No specialized equipment needed for unloading.
- ✓ Low DM loss (< 10%) ... if managed properly!!
- ✓ Fewer safety hazards compared to towers, bunkers, & piles.



## Disadvantages:



- ✓ High annual "out-of-pocket" expense.
- ✓ Larger "footprint" than with towers & bunkers.
- ✓ Most "feeders" do not like feeding from bags!!
- ✓ Disposal of plastic film can be a concern.
- ✓ Lower density & more plastic per ton of silage than with bunkers & piles.
- \*\* This makes bagged silage vulnerable to spoilage losses from punctures.
- ✓ There is an art to making a smooth, dense bag; particularly in hay crop forages.
- \*\* Experience is only way to develop this skill!!



## Disadvantages:



- ✓ DM loss can exceed 20 to 25% if bags are not managed properly from filling thru feedout.
- ✓ Losses can also be highly variable from bag to bag, especially if holes & tears are not found & patched.
- ✓ Flooring or "pads" can be a substantial added expense.
- \*\* And ... bags in the "mud" are a real pain-in-the-neck!!
- ✓ Raccoons can be a big problem in bagged corn silage. It is worse than with bunkers & piles because of the lower density & greater dependency on plastic.

And then there's the mold!

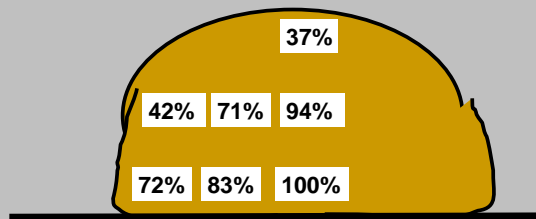


## Density and Losses in Bagged Silage

Rich Muck, Dairy Forage Res. & Brian Holmes, U. of WI



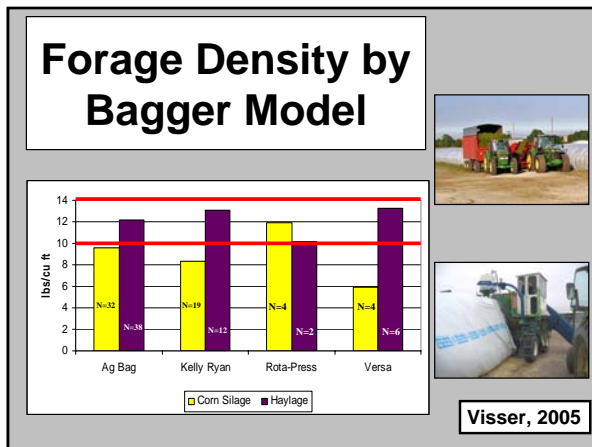
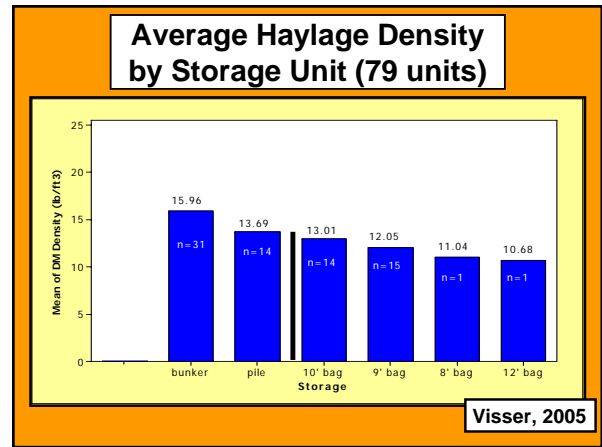
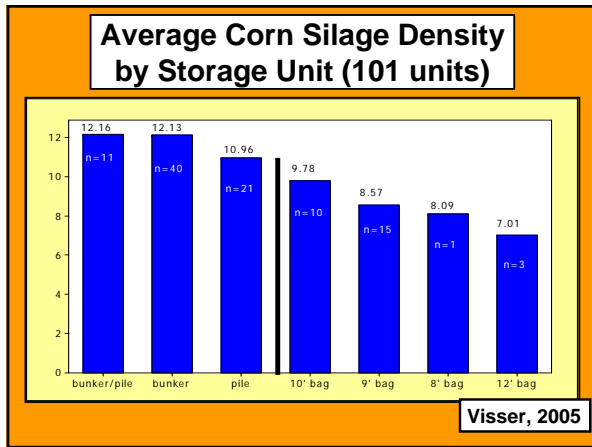
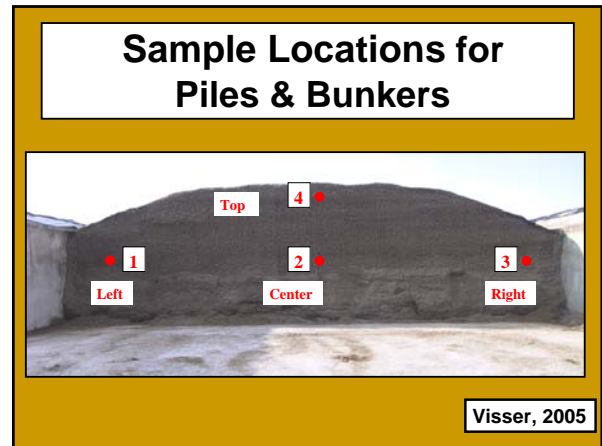
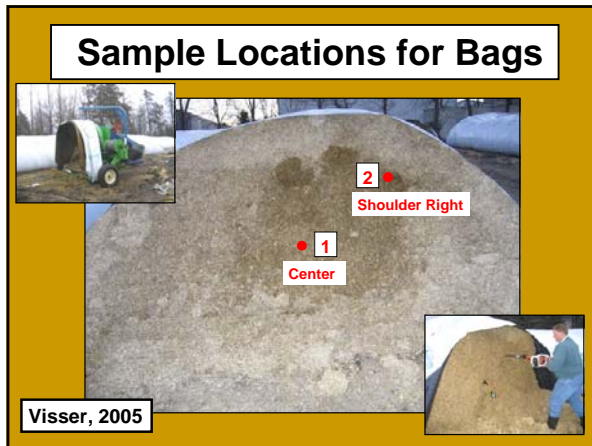
## Density Variation on the Face



## Forage Density and Fermentation Variation: A Survey of Minnesota & Wisconsin Dairy Farms

By: Barry Visser of Vita Plus  
4-State Dairy Nutrition & Management Conference  
June 16, 2005





### Bunkers, Piles, or Bags: Which is the most Economical?

K.C. Dhuyvetter<sup>1</sup>, J.P. Harner<sup>1</sup>, J.F. Smith<sup>1</sup>, G. Boomer<sup>2</sup>, & R. Rodriguez<sup>2</sup>

<sup>1</sup>Ag Economist, Ag Engineer, Dairy Scientist, respectively, at Kansas State University. <sup>2</sup>Technical Service Specialist at Monsanto Dairy Business.

<http://www.agmanager.info/livestock/budgets/production/default.asp#Dairy>

### Comparison of Economic Costs – Example Dairy

The production-adjusted cost per ton of corn silage delivered to cows was estimated for a case study 3,000-cow dairy.

The following assumptions were made:

Herd size, no. of cows	3,000
Silage in ration, as-fed lbs/cow/day	45
Corn silage DM content, %	32
Maximum feeding days per storage structure	122 (implies minimum of 3 structures)
Interest rate, %	10
Land value, \$/acre	1,000
Useful life for structures, years	30
Annual repair and maintenance per structure, %	1.5
Cost of silage delivered to storage, \$/as-fed ton	\$25.00
Cost of plastic, \$/sq ft	\$0.03
Labor cost, \$/hr	\$10.00
Milk price, \$/cwt	\$13.50



### Assumptions for the dairy continued:

	Concrete bunkers	Drive-over piles	Silage bags
Required number of storage units <sup>a</sup>	3.9	4.0	40.0
Silage density, lbs/sq ft	45	45	45
Size of footprint, acres <sup>a</sup>	2.5	3.5	4.7
Cost of floor/base, \$/sq ft	\$1.80	\$0.90	\$0.90
Estimate of DM loss (storage & feed out), %	23	25	11
Investment in structure, \$/as-fed ton capacity <sup>a</sup>	\$59.72	\$23.96	\$24.59
Cost of packing or bagging, \$/as-fed ton	\$1.10	\$1.10	\$6.00
Hours for covering silage, man-hrs/unit	50	50	0
Other annual storage-related costs, \$/unit <sup>b</sup>	\$500	\$500	\$100
Change from baseline milk production, lbs/day	0	0	1.0

<sup>a</sup> Based on specific assumptions not provided here and calculated in *SilageStorage\$.xls*.

<sup>b</sup> Estimated costs for disposing of plastic covers and bags.



Table 2. Economic comparisons of alternative silage storage systems.

Storage-type specific inputs	Concrete bunkers	Piles	Silage bags
Tons of silage stored, as-fed basis	31,997	32,850	27,683
Total DM loss, %	23.0%	25.0%	11.0%
<b>A. Full cost scenario</b>			
Structure investment per ton of storage capacity, \$/ton as-fed	\$59.72	\$23.96	\$24.59
Annual cost of structure & land, \$/ton AF	\$7.24	\$2.91	\$2.99
Total cost of silage into storage, \$/ton as-fed	\$33.46	\$29.13	\$34.14
Total cost of silage out of storage, \$/ton as-fed	\$43.45	\$38.84	\$38.36
<i>Silage cost adj. due to quality (bag silage = 1.0 lb. more milk)</i>			
Milk prod. adj. cost of silage out of storage, \$/ton as-fed	\$43.45	\$38.84	\$33.02
Milk prod. adjusted cost of silage out of storage, \$/ton of DM	\$135.78	\$121.37	\$103.18

### Assumptions for the dairy continued:

	Concrete bunkers	Drive-over piles	Silage bags
Required number of storage units <sup>a</sup>	3.9	4.0	46.0
Silage density, lbs/sq ft	45	45	37.5
Size of footprint, acres <sup>a</sup>	2.5	3.5	5.3
Cost of floor/base, \$/sq ft	\$1.80	\$0.90	\$0.90
Estimate of DM loss (storage & feed out), %	18	18	8
Investment in structure, \$/as-fed ton capacity <sup>a</sup>	\$59.72	\$23.96	\$24.59
Cost of packing or bagging, \$/as-fed ton	\$1.10	\$1.10	\$6.00
Hours for covering silage, man-hrs/unit	50	50	0
Other annual storage-related costs, \$/unit <sup>b</sup>	\$500	\$500	\$100
Change from baseline milk production, lbs/day	0	0	1.0

<sup>a</sup> Based on specific assumptions not provided here and calculated in *SilageStorage\$.xls*.

<sup>b</sup> Estimated costs for disposing of plastic covers and bags.



Table 2. Economic comparisons of alternative silage storage systems.

Storage-type specific inputs	Concrete bunkers	Drive-over piles	Silage bags
Tons of silage stored, as-fed	30,046	30,046	26,780
Total DM loss, %	18.0%	18.0%	8.0%
<b>A. Full cost scenario</b>			
Structure investment per ton of storage capacity, \$/ton as-fed	\$56.23	\$22.12	\$27.89
Total cost of silage into storage, \$/ton as-fed	\$33.03	\$28.91	\$34.57
Total cost of silage out of storage, \$/ton as-fed	\$40.28	\$35.26	\$37.57
<i>Silage cost adj. due to quality (bag silage = 1.0 lb. more milk)</i>			
Milk prod. adj. cost of silage out of storage, \$/ton as-fed	\$40.28	\$35.26	\$32.05

Table 2. Economic comparisons of alternative silage storage systems.

Storage-type specific inputs	Concrete bunkers	Drive-over piles	Silage bags
			
<b>B. Bunker silo ownership cost = \$0 scenario</b>			
Total cost of silage into storage, \$/ton as-fed	\$26.22	\$29.13	\$34.14
Total cost of silage out of storage, \$/ton as-fed	\$34.05	\$38.84	\$38.36
<i>Silage cost adj. due to quality (bag silage = 1.0 lb. more milk)</i>			
Milk prod. adjusted cost of silage out of storage, \$/ton as-fed	\$34.05	\$38.84	\$33.02

At this point, “subjective” factors should be considered to make the FINAL decision!!



### Inoculant **PROFITABILITY** for bagged silage

1. 75 lbs of milk/cow/day
2. 52 of DMI/cow/day\*
3. Milk price = **\$12**  
\*20 lbs haylage and  
\*45 lbs of corn silage



Bottom Line	Corn Silage	Haylage
Inoculant cost/cow/day	1.0¢	0.8¢
↑ net income/cow/day	10.8¢	11.6¢
↑ net income/cow/year	<b>\$32.88</b>	<b>\$35.50</b>

Table 1. Inoculant-treated alfalfa haylage & other grain/forage inputs in the lactation ration.



Ingredients	DM intake lbs / day	DM, %	As-fed, lbs / day	As-fed, \$/ lb	Feed cost, \$/ day
Corn silage	15.0	33.3	45.0	0.0175	0.79
Alfalfa haylage	9.0	45	20.0	0.035	0.70
Other forage	4.0	88	4.6	0.060	0.27
Grain/supplement	24.0	88	27.3	0.075	2.05
Total	52.0		96.9		3.81
Haylage required / cow / year, tons					3.26
Inoculant cost / ton of crop ensiled,					0.75



Table 2. Inoculant-treated alfalfa haylage profitability.

Component	Untreated haylage	Inoculated haylage
<b>Preservation Efficiency</b>		
Silage DM recovery, %	92.0	+ 1.5% units 93.5
Extra cow days/ton of crop ensiled, days		1.5
Milk production, lbs/cow/day	75.0	75.0
Extra milk value/ton of crop ensiled, \$		\$13.50
<b>Utilization Efficiency</b>		
Extra milk/cow/day, lbs		+ 0.25
Extra milk value per/ton of crop ensiled, \$		\$2.81
<b>Combined Efficiencies</b>		
Extra milk value/ton of crop ensiled, \$		\$16.30
Added feed cost/ton of crop ensiled, \$		\$3.10
Net extra milk value/ton of forage ensiled, \$		\$11.65
Added inoculant cost/cow/day, ¢		0.8¢
Added income as milk/cow/day, ¢		12.4¢
Added net income/cow/day, ¢		11.6¢
Added net income/cow/year, \$		<b>\$35.50</b>

### Better Bagged Silage: What's Important??

Comments from nutritionists & dairy producers:

1. Location is everything.
  - a. Keep bags out of the mud.
  - b. Easy access for the feeders.
2. A skilled bagging machine operator is absolutely essential.
3. Keep track of DM content going into all bags, especially in hay-crop silage.
  - a. Use a paint can!!
  - b. Do not feed silage from a bag that contains a wide range in DM content to close-up, fresh, & high producing cows.
4. Do not bag alfalfa “wet”!!
5. Bag all “problem” forages ... keep them out a bunker or pile.

Bottom line: We would like for all of our dairies to have access to a bagger!!



## Better Bagged Silage: What's Important??

Comments from nutritionists, contractors, & dairy producers:

1. **Spray paint to mark potential trouble spots in ALL bags**, including field changes, delay in harvest, etc. These are cheap reminders!!
2. The **bagging operator skill level** is even more critical in bagging than the pack tractor operator in a bunker or pile.
  - \*\* Much higher surface to volume ratio in a bag vs. bunker, and much higher risk/reward relationship.
3. Watch rate of fill/quality of pack-bagging. **Temptation to "push" too many tons too fast.**
  - \*\* Need **confident, respected operator** willing to be firm on bagging rate.
4. **Watch spacing between bags** to make certain bags are not too close together, less critter and pest accumulation.



## Better Bagged Silage: What's Important??

Comments from nutritionists, contractors, & dairy producers:

**Location is the number one management issue.** I have had way too many clients put bags in areas that were not meant for bags!!

**Monitor bags for punctures.** Keep the area mowed and free of becoming a dumping area.

Make sure we are taking enough off the face of the bag. **Bags first started at 8 and 9 ft diameter, and now we are up to 12 ft.** That is a lot more surface to remove per day (especially if multiple bags are open at same time).

\*\*I have had dairy clients bag "wet" haylage, and most of them have been fortunate NOT to have a problem (butyric acid!!) ... **they're dodging a bullet!**



## Better Bagged Silage: What's Important??

Comments from one nutritionist:

Do NOT use bags as bunker silo walls!!



And do NOT use round bales for bunker silo walls, either!!



## Better Bagged Silage: What's Important??

Comments from nutritionists, contractors, & dairy producers:

1. I prefer to have the **same (experienced!!) person operating the bagger** to insure a consistent, uniform fill & density.
2. **Bags need to be on a well-drained, firm surface ... preferably concrete or asphalt.**
  - \*\* Some of my producers use bags (on soil) because they believe the cost of concrete or asphalt is not justified.
  - \*\* A gravel or granite base is an option, but I hate to find mud and gravel in the TMR!
3. Leave enough space between bags to mow the weeds, grass, etc.
4. **Check all bags every Monday, Wednesday, & Friday and make mend/patch the holes.**
5. Mark (paint) every bag with number, date, crop, farm/field, expected use (which cattle description, and misc. (i.e., a new seeding).
5. At feedout, peel back only enough plastic to equal the amount of silage needed daily.
  - \*\* I see **too many bags that have silage exposed for days.**
  - \*\* **Remove silage from the north in the summer months.**



## "Doc, here's why I like my dairy producers to feed bagged silage"!!



## Feeding from bags might be a pain-in-the-neck, but it's SAFE!!





**Good bagged silage is no accident: it takes sound management & attention to detail!!**



**THANKS!**



[www.oznet.ksu.edu/pr\\_silage](http://www.oznet.ksu.edu/pr_silage)

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