BUNK SILO FILLING TAILGATE MEETING

DATE HELD: _____________________

MEETING RUN BY: _____________________

TOPICS COVERED:

- Light, horn & backup alarm check on trucks before starting
- Trucks pulling off and onto road
- Two-way radios confirmed working
- Right of way confirmed for trucks entering and exiting
- Coordination of dumping with packing tractor
- Understanding correct order of load dumping
- Drivers stay in trucks unless an emergency occurs
- Always notify packing tractor before exiting trucks
- Always obey the rules and NYS highway laws while driving

I the undersigned, understand the rules and precautions as stated above and have no further questions regarding the safe transportation of this year's silage crop into the bunk silo area.

EMPLOYEE SIGNATURE ______________________________________

SUPERVISOR SIGNATURE ______________________________________

BUNK COVERING TAILGATE MEETING

DATE HELD: ___________________________

MEETING HELD BY: ___________________________

TOPICS COVERED:

- No horseplay or shoving while performing this task. Bunk plastic can be slippery and falls are a possibility as a result of carelessness.
- Stay at least ten feet from the edge of the bunk wall that has no earthen berm next to it.
- Stay alert of the tractor carrying the tires up the silage pile. DO NOT get behind the tractor for any reason.
- At least one person on the covering team must have a radio to communicate with the tractor driver.
- Tractor operator MUST wear seat belt during this operation.
- Work as a group: cooperate, coordinate and watch out for each other!

EMPLOYEE SIGNATURE ______________________________________

SUPERVISOR SIGNATURE ______________________________________

Making Great Corn Silage!

Controlling the Front End of Silage Fermentation

- Chop to release moisture and sugars
- Pack quickly
- Pack tightly to removed air from the forage mass
- Seal quickly
- Use an inoculant

Source: Limin Kung Jr, University of Delaware. "Managing Your Inoculants for Silage"

INSIDE FOR FALL 2015:

Cornell University
Cornell Cooperative Extension
South Central New York Dairy & Field Crops

South Central New York
Tompkins Cortland Chemung Tioga Broome
Area Dairy & Field Crops Team

Staging Corn Maturity for Harvest

When will corn be ready? Planting was staggered this year and maturities are following suit. Dry matters measured the first week of September indicate that things may be drier than we'd expect.

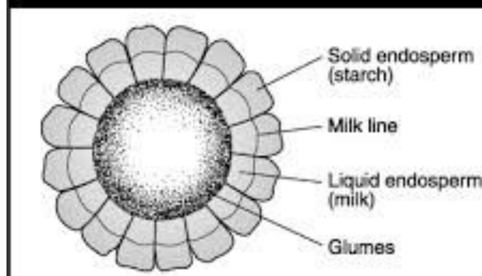
60 days, that's the length of time, on average, that it takes for corn silage to mature from silking (pollination) to blacklayer (physiological maturity). We use ½ milkline as the point to start checking whole plant moisture. Seventy percent moisture is the accepted target for beginning harvest, but consideration needs to be given to your farm storage. Bunk silos pack better at the top of the range, while uprights may have excessive seepage above 68% moisture. (See Table 1. Target Crop DM Levels for Vertical Silage Systems.) Dry matter tests will run 2-3 points above actual field conditions (aka field will be wetter).

Knowing the maturity of your crop and how many days or weeks it takes to harvest allows you to target the moisture for beginning harvest. (See Table 2. Influence of Corn Maturity.) Moisture will decrease by .5-1 point/day depending on the weather conditions. See Table 3. Description of Kernel Growth Stages and Development to estimate when your fields will be ready for silage and grain.

Table 1. Target Crop DM Levels for Vertical Silage Systems

Oxygen limiting structure	
Corn silage	40-65% DM [35-60% moisture]
Conventional Concrete & Stave Structure	
Corn Silage :	
Under 60 feet	32-36% DM [64-68% moisture]
Over 60 feet	Increase 2% DM per 10 ft vertical height
Source: Mike Hutjens, U of Illinois, Urbana. http://qualitysilage.com/wp-content/themes/twentyten/PDF/TowerSiloManagement.pdf	

Corn Cob Cross Section



This cross section of the tip half of a corn cob shows the kernel's milk line progression.

TABLE 2. Influence of Corn Maturity on Grain Yield, Whole Plant Silage Yield and Moisture Content

			% Max Yield		% Moisture	
Maturity Stage	**Avg cal Days To Maturity**	**GDU to Maturity**	**Grain**	**Whole Plant**	**Grain**	**Whole Plant**
Silk	50-55	1100-1200	0	50-55	---	80-85
Blister	40-45	875-975	0-10	55-60	85-95	80-85
Late Milk	30-35	650-750	30-50	65-75	60-80	75-80
Early Dent	20-25	425-525	60-75	75-85	50-55	70-75
Full Dent (1/2 Milkline)	10-15	200-300	90-95	100	35-40	65-70
Blacklayer	0	0	100	95-100	25-35	55-65
Assumes 20 GDU/day to maturity. Adapted from Carter, P.R. 1993. Pioneer Hi-Bred International, Inc..						

Ensiling: The Science of Silage (cont'd)

Mike Rankin & Team Forage, U of Wisc.

ANAEROBIC FERMENTATION PHASE (cont'd)

In corn silage the active anaerobic fermentation process generally lasts less than a week. The rate of fermentation depends on the quantity and type of LAB present on the crop at ensiling and the moisture content of the silage. Wetter forages ferment faster than drier ones.

STORAGE PHASE

During the storage phase the pH of the ensiled material remains relatively stable and there is minimal microbial and enzymatic activity if the ensiled crop is kept anaerobic.

The major factor affecting silage quality during the storage phase is entry of oxygen into the silo. Oxygen increases yeast and mold growth, which results in dry matter loss and heating in the ensiled forage.

The amount of top silage is directly related to the density of the silage and the amount of exposed surface area. The worst-case scenario would be an uncovered silage pile put up too dry and poorly packed. Aerobic losses under these circumstances can approach 20%. Other causes of excessive storage loss are cracks in silo walls, poorly sealed doors in upright silos and rips in plastic covers or bags.

FEEDOUT PHASE

The feedout phase begins once the silo is opened and continues until the silage is consumed. Once silage is re-exposed to oxygen, yeasts and molds become active again. They convert residual sugars, fermentations acids, and other soluble nutrients into carbon dioxide, water, and heat. Feedout losses can represent up to 30% of the total dry matter loss in the ensiling process.

Generally, the first signs of aerobic deterioration are heating and an off odor, followed by fungal growth on the surface of the silage and/or in the feedbunk. By the time fungal growth appears, substantial amounts of dry matter and nutrients have already been lost. Besides the loss of highly digestible nutrients, some molds can produce mycotoxins which can cause illness or reduced performance in livestock.

Higher levels of aerobic microorganisms present in the silage will cause the silage to deteriorate faster when re-exposed to oxygen on feedout. The level of aerobic microorganisms present in the silage is largely determined by their presence on the crop before harvest and their level of growth during the initial aerobic phase. Although many yeasts and molds can survive the low pH levels typically achieved in silage, the acidic environment restricts their growth. Thus, a pH of 4 or less helps make the silage aerobically stable during feedout.

The type and amount of fermentation acids produced during the fermentation will also affect the degree of aerobic stability of the silage. A typical fermentation profile for well-fermented corn silage is listed in table 10. Some acids produced during fermentation are more toxic to yeasts and molds than others. Butyric acid is the most toxic followed by propionic and acetic acid. Lactic acid is the least effective at suppressing the growth of yeasts and molds. Thus, the aerobic stability or bunk life of silages produced by the most efficient homofermentative lactic acid fermentation is often poorer than malfermented silage containing elevated levels of butyric and/or acetic acid.

The level of residual sugar remaining in the silage after fermentation can also influence aerobic stability. Yeasts and molds grow approximately twice as fast on sugars as they do on fermentation acids. Silage produced from immature corn silage will generally have higher levels of residual sugars and are more prone to aerobic deterioration on feedout.

The ambient temperature has a major influence on the aerobic stability of silage. Microbial growth rates increase exponentially with temperature up to approximately 130^0 F. This means silage fed out during warm weather deteriorates faster than silage fed out during cooler weather.

Table 10. Typical fermentation profile for well-fermented whole plant corn silage.

Profile	**Analysis**
Silage pH	3.6-4.0
Fermentation end-products	4-6%
Lactic acid	<2%
Acetic acid	<0.1%
Propionic acid	<0.5%
Ethanol	<0.5%
Nitrogen fractions	
Ammonia nitrogen	<5% of total N
ADIN (bound N)	<12% of total N
Microbial assay	
Yeast <100,000 CFU[1]/g of silage	
Molds<100,000 CFU/g of silage	
Total aerobes <100,000 CFU/g of silage	

[1]CFU = colony forming units.

Ensiling: The Science of Silage

Mike Rankin & Team Forage, U of Wisc.

FERMENTATION PROCESS

Plant sugars are fermented by anaerobic bacteria to organic acids which reduce the pH of the plant material. This process preserves the crop during long-term storage. The efficiency of fermentation and amount of fermentation loss is influenced by a number of factors; the ability to achieve and maintain anaerobic (without oxygen) condition in the silo, the amount of fermentable sugars in the crop, the quantity and type of bacteria present on the crop, and the quantity and type of fermentation acids produced.

High quality corn silage results when lactic acid is the predominant acid produced during fermentation. Lactic acid is the most efficient fermentation acid and will drop the pH of the silage the fastest. Under proper ensiling condition corn silage will normally ferment rapidly and achieve a stable pH of 4.0 or below within the first week after ensiling.

The major chemical and microbiological changes that occur during the fermentation process can be divided into four distinct phases: aerobic, anaerobic fermentation, storage, and feedout.

AEROBIC PHASE

The aerobic phase of fermentation begins at harvest and continues until the oxygen is depleted, shortly after ensiling. During this stage, plant sugars in the freshly chopped plant material are broken down to carbon dioxide, water, and heat in a process known as respiration. Aerobic microorganisms (yeast, molds, and aerobic bacteria) present on the chopped plant material also use plant sugars during this initial phase and are a significant source of respiration. Increased growth of yeasts and molds during this phase can predispose the silage to heating and spoilage during the feedout phase.

Respiration hurts silage quality because it uses highly digestible energy, reduces the amount of material available for the beneficial lactic acid bacteria, and produces heat. Temperatures above 100^{0} F can produce heat-damaged protein (ADIN) which is unavailable to the animal. Under normal ensiling conditions the temperature of the ensiled material will peak at 15^{0} F to 20^{0} F above the ambient temperature at the time of ensiling. If the temperature of the silage exceeds this level, extensive respiration has occurred.

Another important chemical change that occurs during the aerobic phase is the degradation of plant proteins to nonprotein nitrogen (NPN), peptides, amino acids, and ammonia by plant cell proteases. The extent of proteolysis will depend on the rate of pH decline, temperature and moisture content of the ensiled crop. In corn silage, the NP level can increase from 20% of total nitrogen in the pre-ensiled forage to over 50% within 24 hours post-ensiling. Proteolysis is not desirable, particularly for high-producing dairy cow, because excess soluble nonprotein nitrogen results in poorer efficiency of nitrogen utilization and lower milk production. Likewise, elevated levels of ammonia nitrogen in silages have been associated with lower dry matter intake.

The aerobic phase reduces silage quality and should be minimized. Under good management practices the aerobic phase will last only a few hours. With improper management i.e., harvesting the crop too dry, poor compaction, poor chop length, slow filling, and/or not covering the silos this phase may continue for several weeks.

ANAEROBIC FERMENTATION PHASE

Once the oxygen has been depleted the anaerobic fermentation phase begins. During this phase a succession of different populations of anaerobic bacteria ferment sugars. The sugars are converted primarily into lactic acid, but also acetic acid, ethanol, carbon dioxide, and a few other minor products. The production of acid lowers the pH of the ensiled crop which inhibits the growth of other microbes.

The principal bacteria for ensiling are the lactic acid bacteria (LAB). LAB are divided into two broad categories. The homofermentative LAB produce acetic acid and carbon dioxide as well as lactic acid. Homofermenters are more desirable than herofermenters because their fermentation is more efficient, resulting less loss of dry matter and energy.

Initially, the heterofermentative LAB are predominant. These organisms remain active until the pH of the ensiled material drops below 5. As the pH of the ensiled forage reaches 5, the homofermentative LAB become predominant. These bacteria are extremely acid tolerant and grow quickly. Since they produce only lactic acid, the silage pH drops more rapidly. The bacteria remain active until the silage reaches a stable pH of 4 or below, or until the fermentation sugars are depleted.

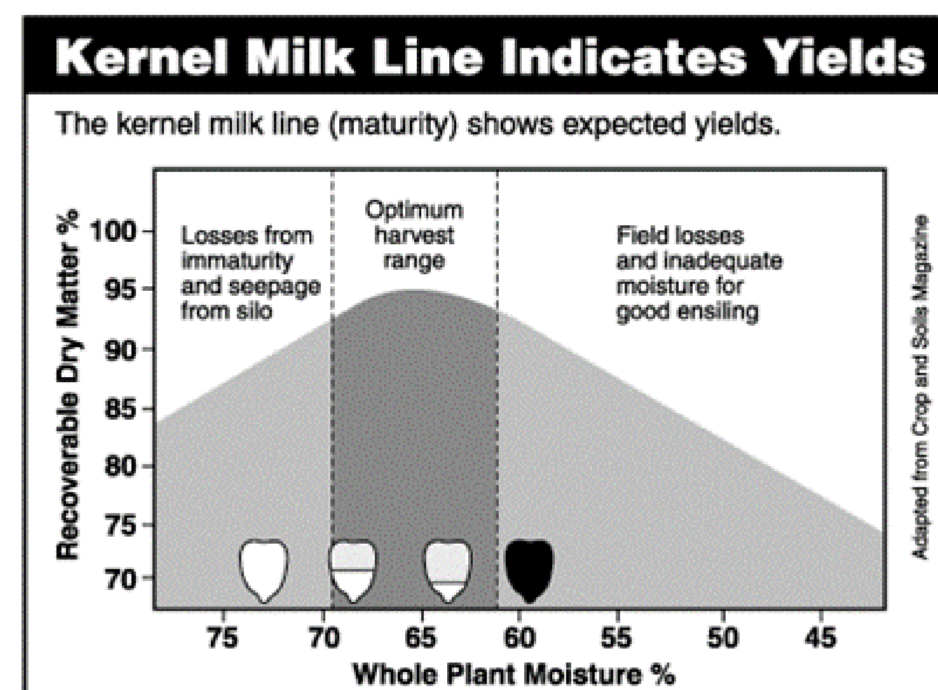
When the natural population of LAB is very low, acetic acid bacteria may proliferate. These bacteria are less desirable than LAB since they produce mainly acetic acid which slows the drop in pH, increases dry matter losses, and can reduce dry matter intake in beef and dairy cattle.

TABLE 3

Description of Kernel Growth Stages and Development

Stage	Description
Silk	Silks are emerged and tassel is shedding pollen.
Blister	Within two weeks after silking, kernels are white on the outside and resemble a blister in shape. The cob is close to or at full size.
Milk	By the end of third week after pollination, kernels display a yellow color on the outside and the inner fluid is milky-white due to accumulation. Kernels taste like "sweet corn".
Soft Dough	Starch accumulation continues into the fourth week as the milky inner fluid now thickens to a pasty consistency. Kernels begin to taste more like "cow feed". Kernels have accumulated close to half their mature weight. Some dents are now visible at the attachment (butt) end of the ear. The interface between the hard starch above and the milky, liquid material below is termed the milkline.
Early Dent	Visible dent on 95% of the kernels.
1/3 Milkline	The milkline is about 1/3 of the way between kernel crown and tip. Whole plant moisture is ideal for bunker silo storage at approximately 68-72% moisture.
Full Dent	All kernels are dented. Kernels easily cut with a fingernail. It takes approximately 10 days to go from full dent to 1/2 milkline.
¼ - ½ Milkline Harvest	Milkline is about ½ the distance between the kernel crown and tip. About 95% of the grain yield potential has been achieved. Whole plant moisture is ideal for ensiling in a tower silo at approximately 63-68% moisture.
¾ Milkline	Milkline positioned ¾ of the way from kernel crown to tip. Whole plant moisture is between 63-68% depending upon hybrid.
Mature (blacklayer)	All milk has disappeared from the kernel. The hard starch has advanced completely to the cob with a brown or black abscission layer developing at the tip of the kernel. The black layer formation occurs progressively from the tip ear kernels to the basal kernels of the ear. The black layer is caused by the collapsed and compression of several layers of cells near the tip of the kernel. Environment (cool weather) can cause premature blacklayering. Harvest of High-moisture corn should be delayed until black layer (and proper ensiling moisture depending upon structure). Whole plant moistures will be below 60% and not suitable for proper corn silage compaction and fermentation.

Adapted from Corn Management and diagnostic Guide. Pioneer Hi-Bred Int., 1987 (28) and Pioneer Crop Insights. March 1994 (5).



Silage Preservation: First Things First

Brian J. Holmes, Biological Systems Engineering Department, University of Wisconsin – Madison

Harvest at Correct Stage of Maturity

Why? High levels of readily available carbohydrate are needed to ferment into acids.

What Stage? Alfalfa-early to mid bloom, Corn – 1/3 – ½ half milk line

Harvest at Correct Moisture

Why? Too dry – high porosity (oxygen penetration, reduced acid production, reduced thermal mass (rapid heating)

Too wet – Clostridial fermentation (Butyric acid), Leachate discharge (nutrient losses)

What Moisture? Alfalfa – 60-65%, Corn – 65-70%

Chop to Correct Particle Length

Why? Shorter particles pack better and release more soluble carbohydrates

How? Set knives to obtain 3/8th inch TLC for hay and unprocessed whole plant corn and ½-3/4 inch TLC for processed whole plant corn.

Size Silo Properly

Why? To remove silage at a high rate (keeps ahead of spoilage) To avoid safety problems (avalanche of overhang)

How? Select face cross section to achieve 12" per day removal based on volume removed each day. Stack silage so it is no higher than the unloading equipment can reach (no overhangs). Remove no less than 6" per day

Seal Silo Cracks and Holes

Why? Limits oxygen penetration

How? JetCrete, Epoxy, Grout, Plastic Sheets

Harvest at High Enough Rate to Fill Silo in Three Days

Why? While silos are open, forage is exposed to oxygen thus supporting microbial deterioration. Exposed forage is also susceptible to precipitation which can leach soluble carbohydrates.

How? Size silos small and/or provide enough equipment and labor to harvest and transport forage quickly.

Pack Forage to a High Bulk Density

Why? High bulk density has low porosity (limits rate of oxygen transmission through silage)

How? Proper forage moisture (60-70%), Thin filling layers (<6 inches), Heavy Tractor(s), Pack continuously, Pack whole surface (keep packing slope shallow), Multiple packing tractors

Seal Forage Against Oxygen Penetration

Why? Oxygen supports aerobic microbial decomposition of silage.

How? Slope forage surface to drain runoff water away from silo wall, cover top surface with 6-8 mil plastic within 24 hrs of filling, weight plastic uniformly to prevent plastic billowing in wind, seal edges with soil or gravel filled bags. Manage vermin which can cause holes. Inspect plastic weekly patching holes as found.

Maintain Tight, Smooth Feed Out Face

Why? Ragged silage has larger surface area exposed to oxygen and fissures and cracks allow oxygen to penetrate deep into silage.

How? Scrape silage at feed out face in a downward motion of the loader bucket or use a facer to remove forage.

Remove Only the Forage that will be Fed in One Feeding

Why? Removed silage is low density which allows oxygen to penetrate deeply.

Rapid heating can result.

How? Pay attention to how much material needs to be removed.

Practice Safety

Why? Injury and death are expensive! It can happen to you.

How? - Four wheel drive packing tractor

- Roll over protection on tractor and use seatbelts
- Experienced pack tractor driver
- Keep pedestrians (especially children) away from filling areas.

The Correct Tractor for Packing (cont'd)

Ron Kuck, CCE Jefferson

age for corn silage. Shrink that was once 23% is now approaching 10% after a few years of focused bunk packing and training of the bunk crew.

You can achieve this on your farm

Remember, Cornell Cooperative Extension of Jefferson County can help your bunk crew build a better and tighter bunk. We have developed a useful "real time" bunk density tool that can evaluate your packing density as you are filling your bunk.

And please, do not try to over-fill bunkers. Big rounded tops (looks like a loaf of bread) do not allow for adequate packing, and are a waste of time, fuel, and forage quality, not to mention this is also dangerous for the packer as well as potential avalanche at feed out.

Ron Kuck is the Dairy & Livestock Educator with Cornell Cooperative Extension of Jefferson County. He can be reached at 315-788-8450 or rak76@cornell.edu

Dry matter loss as influenced by silage density (Ruppel, 1992)

Density (Lbs. DM/ft3)	DM Loss, (%)
10	20.2
14	16.8
15	15.9
16	15.1
18	13.4
22	10.0

Bunk densities revealed that the center of the bunk was now achieving 17# cu ft.

Bunk densities revealed that along the edges it was 15# cu ft.

Scenarios for Trying to Improve Silage Density When Forage Delivery Rate is Increased from 50 T AF to 100 T AF/hr. (Holmes and Muck (1999d)

Variables Changed from the Base Case	**Est. Dry Matter Density** (lbs. DM/ft^3)
No change in packing procedure	12.3
Add 20,000-lb tractor for 50% time	12.7
Add 20,000-lb tractor for 100% time	13.1
Add 5,000 lbs. weight to 30,000-lb tractor and do not use 20,000-lb tractor	13.0
Add 5,000 lbs. weight to both tractors and use both tractors 100% of time	14.1
Reduce layer thickness from 6 inches to 4 inches	14.5
Use both tractors 100% of time and reduce layer thickness to 4 inches.	15.6
Add 5,000 lbs. to 30,000-lb tractor and reduce layer thickness to 4 inches	15.5
Add 5,000 lbs. to both tractors, use each 100% of time, and reduce layer thickness to 4 inches	17.1

The Correct Tractor for Packing

Ron Kuck, CCE Jefferson

Many farms using bunk or drive-over silos for forage storage now are calculating the optimum tractor weight for packing to match the delivery rate of forage. Why? High forage density has low porosity (limits rate of oxygen transmission through silage) which limits spoilage or shrink. Packing is typically the weakest link in bunker silo management. When you see a bunker silo "settle," that is actually fermentation dry matter losses due in part to poor packing. Dense packing reduces dry matter losses, heating problems, and storage costs. The goal is to achieve more than 15 lbs. of dry matter per cubic foot for corn silage and haylage.

Select the correct tractor for packing.

The packing tractor should be as heavy as possible to achieve high forage density. Tractor weight can be augmented by adding weight to the tractor. This caged block not only added weight, but perhaps more importantly concentrated that weight over the axles to increase the downward pressure of the tires. As the harvest rate increases, the need for more than one pushing or packing tractor increases. Do not count the time spent pushing forage as packing weight or time! The packing pattern should allow the wheel patterns in the forage to overlap about half a tire to improve uniformity of packing. When dual wheels are used, try to have a wheel pack the forage left unpacked between the wheels of the previous pass.

Don't forget edges.

Watch near the walls where density has a habit of lightening up. Getting close to the walls is an issue because of fear of drivers getting too close to the wall and blades on packing tractors are wider than wheel base.

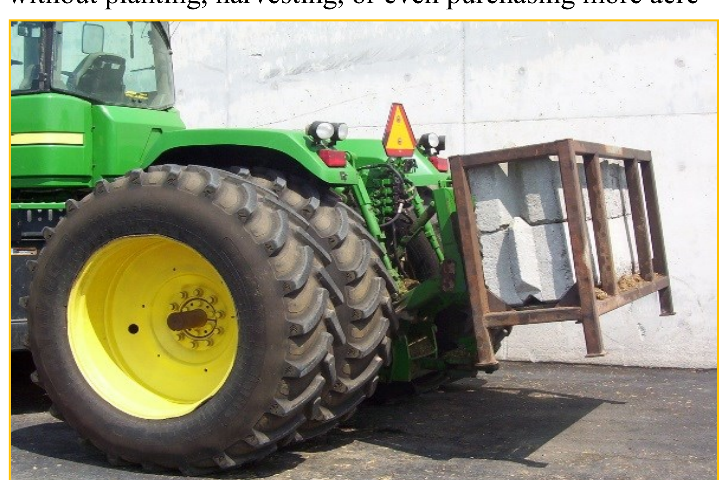
While dual wheels all around will improve traction and tractor maneuverability as well as being your heaviest tractors think about putting your heaviest single tire tractors to pack along the walls and edges.

Will it work?

Cornell Cooperative Extension was at a Sackets Harbor Dairy last fall evaluating packing density in three newly constructed bunk silos. We used our "real time" method of determining packing density to give immediate feedback to farm manager, packing crew, and nutritionist. We found that in the middle of the bunk, densities were satisfactory often exceeding the recommended 15# cu foot. Along the walls however densities had trouble reaching 13# cu ft. Suggestion was made to get heavy single tired (not duals) tractor onto bunk to pack the edges. The bunk crew, despite calculated evidence from our bunk density evaluation, still thought they were doing an acceptable job of packing. To humor the nutritionist, they brought the single tired tractor up on the bunk and drove along the edges. The wheels sunk into the pile and silage rose up to the rim of the tires visually indicating that bunk was NOT packed adequately. Consequently bunks 2 and 3 were packed with two dual tire tractors and a tractor with singles worked along the wall and edges.

Positive results

Note that the feed along the edge is similar to that in the middle. Compare to the poorly packed forage near the wall at the beginning of the article. The feed manager noted that silage went in at 31%DM and feed out six months later is still at 31% indicating very little shrink or loss. The farm manager noted to me that usually at this time of year (July) they start to limit corn silage in the ration to stretch the supply until the new crop is harvested. Not so this year. They will have plenty of corn silage to feed the expanding herd without planting, harvesting, or even purchasing more acre-



Silage Preservation: First Things First (cont'd)

Brian J. Holmes, Biological Systems Engineering Department, University of Wisconsin – Madison

Practice Safety (cont'd)

- Keep packing surfaces at 3:1 slope or shallower

- Don't fill higher than unloader can reach (no overhangs)

- Face wall side of silo when covering and weighting (don't back up to edge),

- Consider guard rails at wall top.

- Use trailer dump while parked only on solid surfaces

- Avoid approaching the feed out face (avalanches are real)

- Avoid standing/walking on top of silo near the feed out face (avalanches are real)

- Don't place forage on top of plastic cover when adding new feed (pull back the plastic first)

How much value can be saved by implementing good silage management practices?

The answer to this question depends on your current management practices. If you need to improve in some practices and can be viewed as doing a moderate job of management, some improvement in savings can be obtained. If on the other hand, large improvement in practices are needed, much greater savings are possible. To help address this issue, a spreadsheet (Determining Value of Improved Silage Management) is available on the Harvest and Storage page of the UW Extension Team Forage web site located at URL: www.uwex.edu/ces/crops/uwforage/storage.htm

The Determining Value of Improved Silage Management spreadsheet was used with the following assumptions to estimate the benefit of moving from not so good management to good management:

100 cow herd with replacements

Hay Silage Value = $125/TDM

Corn Silage Value = $100/TDM

	Losses with Good Management		Losses with Not So Good Management	
Category	Hay	Corn	Hay	Corn
Feeding Loss	5	5	7	7
Feed Out Loss	3	3	5	5
Storage Loss	10	10	15	15
Filling Loss	1	1	3	3
Harvest Loss	6	1	8	2

	Losses with Good Management		Losses with Not So Good Management	
Category	Hay (%)	Corn (%)	Hay (%)	Corn (%)
Value Lost	$11,204	$8,572	$18,649	$14,922
Total Value Lost	$19,776		$33,571	

Results of the analysis are:

With these assumptions and those not presented about the ration formulation, the value of moving from not so good management to good management is $13,795/year ($33,571-$19,766). You can use this spreadsheet to enter your own assumptions about herd size, rations and estimated losses to find a savings for your situation for each management change you attempt and for the total savings.

Shrink – The single biggest opportunity of margin control from feed loss

Tom Zorn, Cows Come First

This topic is nothing new, but totally within each producer's control to manage margin on each farm. How we manage this can ultimately dictate how the farm makes money. Forage holds the key to profitability; quality and shrink go hand in hand. The more we keep oxygen out of the equation at the start and during fermentation, higher quality and less shrink (dry matter loss) is the result.

Imagine you keep more of your hard earned forage on the farm? Reducing shrink 5% is 18 days more forage on the farm to feed in one year's time. If a typical lactating diet fed of 55% forage with nominal cost applied, that can result in $2/cow/day of forage cost. So on a 100 cow dairy, that $200/day or $3600 for those 18 days. This also can be expanded to on farm grains, and ultimately the delivered TMR.

Tips for reducing shrink:

Efficiency at harvest

* Not wasting time. Get the forage in the storage structure as quickly as possible to start high quality fermentation.
* Do not sacrifice safety in this process. Let's all use caution!

Packing

* Harvesters are becoming bigger and more powerful every year. Do not forget to step up the packing methods to accommodate. Get the oxygen out of the forage!
* Packing on bunker silos is key, along with proper moisture. More dense the silage, more nutrients retained to feed cattle and also helps in extending bunk life.
* Adding as much weight to packing equipment, or using add-on rollers, can help. Use the tons/hour guide as a starting point.
* Thin layers while pushing forage across the bunk also is a major consideration to increasing density.
* Lining bunk walls with plastic, using oxygen limiting plastic covers, covering plastic tire to tire are great methods to aid in high quality forage.

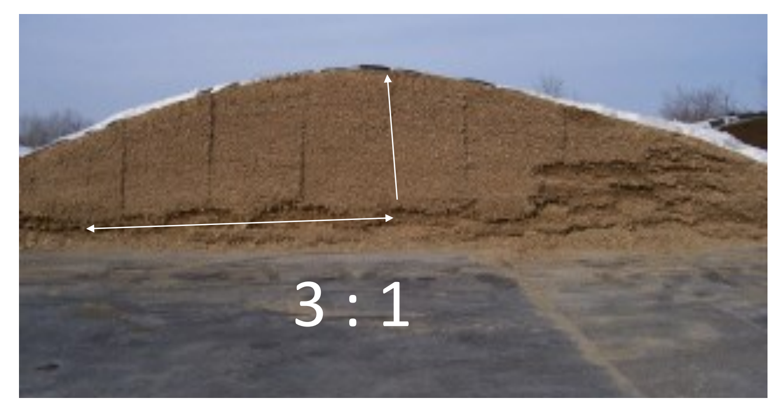
Cost of Dry Matter Shrink Per Ton
When Replaced with Corn Grain as an Equivalent Energy Source

Corn Cost ($/bu) / PERCENT SHRINK	10.0%	12.5%	15.0%	17.5%	20.0%	22.5%	25.0%	27.5%	30.0%
$3.00	$3.78	$4.73	$5.67	$6.62	$7.56	$8.51	$9.45	$10.40	$11.34
$3.50	$4.41	$5.51	$6.62	$7.72	$8.82	$9.93	$11.03	$12.13	$13.24
$4.00	$5.04	$6.30	$7.56	$8.82	$10.08	$11.34	$12.61	$13.87	$15.13
$4.50	$5.67	$7.09	$8.52	$9.93	$11.34	$12.76	$14.18	$15.60	$17.02
$5.00	$6.30	$7.88	$9.45	$11.03	$12.61	$14.18	$15.76	$17.33	$18.91
$5.50	$6.93	$8.67	$10.40	$12.13	$13.87	$15.60	$17.33	$19.07	$20.80
$6.00	$7.56	$9.45	$11.34	$13.24	$15.13	$17.02	$18.91	$20.80	$22.69
$6.25	$7.88	$9.85	$11.82	$13.79	$15.76	$17.73	$19.70	$21.66	$23.63
$6.50	$8.19	$10.24	$12.29	$14.34	$16.39	$18.43	$20.48	$22.53	$24.58
$7.00	$8.82	$11.03	$13.24	$15.44	$17.65	$19.85	$22.06	$24.26	$26.47
$7.50	$9.45	$11.82	$14.18	$16.54	$18.91	$21.27	$23.63	$26.00	$28.36
$8.00	$10.08	$12.61	$15.13	$17.65	$20.17	$22.69	$25.21	$27.73	$30.25

Source: The Silage Zone. DuPont-Pioneer

Drive-over piles and bunkers with walls are very popular storage options on many dairy farms. Sizing of bunks is very important to manage not only the packing and fermentation process, but feed out also. Let's look at building a drive-over pile without walls. These are becoming more popular and might cost less than storage with walls. They are also flexible for sizing providing you have the proper footprint. If built properly you can store and preserve a large amount of forage because of excellent packing and managing the feed out.

It has been estimated that 20 to 25 percent of corn silage stored in these drive-over piles never makes it to the cows because they are not sized and shaped correctly. A properly



shaped pile should have the front, back, and sides at a minimum slope of 3:1. This means that for every 3 feet of width you should have no more than 1 foot of height.

Many folks disregard this and try to put too much forage in a small space and end up with a big pile of you know what (see picture at right). This is not only unsafe to put a tractor and operator on but you can not possibly pack the sides and back very well. This can result in more spoilage and shrink.

To size the pile correctly, you need to first determine feed out every day. Minimum is one foot from the face of the bunk. Recommendations are to have some carryover from year to year so bunk length should be approximately 400 feet (365 days plus at least 30 days). **There are some advantages to making more than pile but total length should equal at least 400 feet.**

An excellent spreadsheet for sizing your drive-over pile from the University of Wisconsin, Extension Forage Team, can be found at http://fyi.uwex.edu/forage/harvest/#sstorage. I can also forward it to you or give me a call and we can work it out with your forage team. And don't forget that CCE of Jefferson County can help your bunk crew build a better and tighter bunk. We have a developed a useful "real time" bunk density tool that can evaluate your packing density as you are filling your bunk or making your drive-over pile. We can demonstrate that the proper run to rise ratio can put and keep more forage in your bunk.

Bunker Silo/Pile Density Study (cont'd)

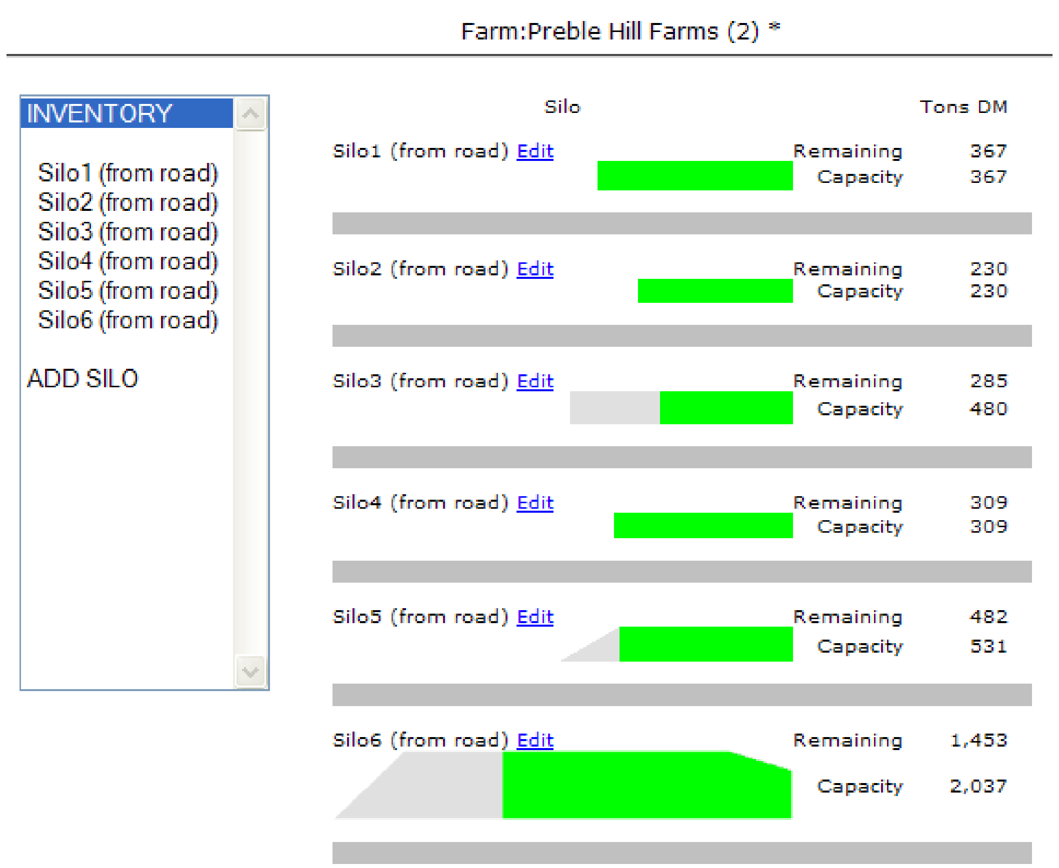
John Conway, Dairy Specialist, PRODAIRY

Figure 1. Before and after bunker silo density comparison

400 Loads		686 Loads
2,356	Tons DM @5.89 tons DM/load	3,991*
-------	Advantage	1.71x or +41.7%
12.4	DM density (lbs./cu. ft.)	21
18.1%	DM lost based on density	10.9%
426	Tons DM lost	435
$30,428	Value tons DM lost @ $25/ton AF	$31,071
1,626 tons	DM needing another "home"	------
($48,780)	Additional silo storage cost @$30/ton DM	------
294	Tons DM lost in extra silo @ 18.9%	------
($21,000)	Value of 18.9% loss in extra silo @ $25/ton AF	------
3,262	Total retained tons DM available for feeding	3,556
-----	Total dollar advantage due to density	$69,137

*Adjusted downward to reflect a slightly longer apron in 2005

SiloStor



What is Your Corn Silage Processing Score?

Dr. Larry Chase, Cornell University; Published in *The Manager*, February 2014

Kernel processing (KP) at harvest is routinely used on many NY dairy farms. This breaks up corn kernels to improve digestibility and use in the cow. A meta-analysis of research data done at the University of Wisconsin indicated that total tract starch digestion increased by 5.9% when KP rolls are set at one to three mm, compared with no processing. They also reported a decrease in the number of whole kernels found in the corn silage when KP is used.

How good should corn silage be processed?

Dr. Dave Mertens, formerly of US Dairy Forage Lab, developed a laboratory method to assess the adequacy of kernel processing. The corn silage sample is dried and shaken for 10 minutes on a series of sieves. The portion of the sample that passes through a 4.75 mm sieve is collected and analyzed for starch. The percentage of the starch that passes through this sieve is termed the corn silage processing score. The guidelines for interpreting the results are:

⇒ greater than 70% = Optimum,

⇒ 50 – 70 = Adequate,

⇒ less than 50% = Inadequately Processed.

What do lab results show for the adequacy of kernel processing?

Cumberland Valley Analytical Services measured the CSPS on 1,131 samples in 2010 to 2012. Only 7% of the samples were optimally processed, while 51% were adequately processed. More importantly, 42% of the samples were inadequately processed. More whole kernels from the inadequately processed corn silage and a lower total tract starch digestibility when fed to the cow are expected. This corn silage has less feed value.

How much impact would this have in a dairy cow?

Dr. Randy Shaver at the University of Wisconsin estimates about two lbs more milk are produced from optimally processed versus adequately processed corn silage. He also estimates about a two lb loss in milk when corn silage is inadequately processed compared with adequately processed corn silage. A number of studies report relationships between the CSPS and fecal starch content. As CSPS decreases, fecal starch increases. A field study of herds conducted by Vita Plus reported that fecal starch averaged 4% for herds fed corn silage with a CSPS >60. However, fecal starch was 6.7% when the CSPS value was <50. Dr. Jim Ferguson at the University of Pennsylvania indicated that a one unit change in fecal starch equates to 0.72 pounds of milk. This would be a difference of about two pounds of milk in the data from Vita Plus.

The challenge with CSPS is that it is a value determined after the corn silage is harvested. What can you do to estimate the degree of kernel processing as the crop is being harvested? A number of options can be used at the field level. These include:

- Pioneer suggests filling a 32 ounce cup with corn silage and looking at the corn kernels. If two or less whole or half kernels are observed, this is considered ideal.

- Put some corn silage in a tub of water and agitate it slightly. The kernels will sink to the bottom. Pour off the water and visually inspect the kernels. Workers at the University of Wisconsin suggest that properly processed corn silage should have almost no cracked or whole kernels.

- Use the Penn State box and look at the kernels in the pan. The guidelines for the water separation procedure can be used to determine the results.

These approaches can be used during harvest to determine if roller settings need to be changed. You may need to make roller setting adjustments a number of times during the harvest process due to changes in dry matter, maturity and other factors. By doing the monitoring and adjustments during harvest, you can improve the CSPS of the silage, increase starch utilization and increase milk production by the cow .

Bunker Silo/Pile Density Study – Findings and Industry Applications

John Conway, Dairy Specialist, PRODAIRY

A NYFVI funded bunker silo/drive over pile density study has been conducted across New York State over the past two years. Intent was to clarify earlier applied research in Wisconsin and other sites by intensively describing silo filling parameters on the way into storage, testing the same material for dry matter density on the way out and squaring that relationship with spreadsheet density estimation tools. Project participating dairy producers would be interviewed throughout 3 crop seasons to determine what additional decision enhancing tools would benefit their businesses.

124 dry matter density samples were taken from 68 silo faces representing as many as 5 cuttings of hay crop silage (legume, mixed and straight grass), conventional corn silage and silos filled with BMR corn silage. At fill data recorded included loads per hour, total tractor weight, average blade layer, dry matter content estimates relative to 35% DM (wetter, close to 35% or dryer) and packing "persistence" (packing tractors consistently on the move). Density measures were standardized to 6' from top centered between sidewalls for hay crop silages and 6' from top plus two additional samples at equidistant intervals between the 6' sample and the silo floor in corn silages. (corn silage silos of universally greater height). Particle length of silage determined in year 1 and observed only for unusually long or short thereafter, Center height of silage also determined at sampling.

Earlier estimates of how packing tractor weight, silage dry matter, rate of fill and blade layer work together to affect dry matter density were incorporated into the University of Wisconsin spreadsheets *Bunker Silo Density Calculator* and *Silage Pile Density Calculator* (both on distributed CD). Results of this study provide these adjustments to numbers coming out of these useful and reasonably accurate spreadsheets:

What We've Found:

✧University of Wisconsin spreadsheets for predicting density of bunkers and piles remain the most reliable tool out there. But…

-Legumes, particularly when drier, tend to run slightly higher than predictions. The "glueyness" factor.

-Corn silage trends slightly lower than predictions –sometimes due to loads being dumped faster than you think they are.

-Grass really resists compression. It is also tough to blade as it wants to roll. We need more data. Same equipment and delivery rates and it's up to 5 $lbs./ft.^3$ lower. More storage needed!

✧You can use your own "tested" density predictions to arrive at a "smaller silo space required" compared with average densities. This allows bunkers or piles to be compared fairly with other storage systems or with each other.

✧Water trapped in plant material occupies space. Wetter materials do not achieve the dry matter densities of similarly packed drier materials.

-Top notch packing does not help with consequential fermentation problems (i.e. butyrate) when silage is put up too wet (<33% DM legumes and grasses).

-Top notch packing does allow you to push the envelope on the dry side without apparent consequence (42 - 55% DM legumes and maybe up to 45% DM in grasses).

✧BMR corn silage trends to pack to a greater dry matter density than conventional corn silage under the same packing dynamic. Something to consider when making financial comparisons.

✧While dry matter losses translate easily into dollars, it is the cost of additional storage needed with sub-optimal densities that really drives up storage costs.

✧A **haylage silo filling strategy** that seems to work well… use a long ramp to keep blade layer minimized. When stretching out the life of silo; layering a subsequent cutting on top and in front of initial cutting will compress the lower material even more. Useful when you need to stretch the utilization of a silo while minimizing losses.

✧When corn silage (or haylage) is so far over the sidewalls that it looks like a bread loaf, it's time to consider more packing weight or even better, a new silo! A lot of diesel and labor is spent on not a lot of dry matter!

On the financial side, several opportunities allowing a reasonable estimate of improvement costs to be compared with the value of reduced losses resulted in solid net returns. Interestingly, and in most cases, the enhanced use of limited silo space (not having to find a different silo "home" for the forage that did not fit) returned close to double the value of reduced dry matter losses. A generalized scenario, followed by an actual measured farm scenario demonstrates this relationship.

What's Happening in that Cubic Foot of Bunker Silo Storage "Space"?

- 32'W x 106'L x 10'H = 33,900 $ft.^3$
- Capital Cost structure plus share of tractors = ~$61,000
- Capital Cost per ft.3 = $1.80
- Annualized Capital Cost per $ft.^3$
  (10 yr. depreciable life) = $0.18
- 13 lbs. forage DM/ $ft.^3$ density @ 17.5% storage loss = 10.7 lbs./ft.3retained
- 18 lbs. forage DM/ $ft.^3$ density @ 13.4% storage loss = 15.6 $lbs./ft.^3$ retained
- Value of 10.7 $lbs./ft.^3$ @ $0.05/lb.* over 33,900 $ft.^3$= $18,136.00
- Value of 15.6 $lbs./ft.^3$ @ $0.05/lb.* over 33,900 $ft.^3$ = $26,442.00
- A 38% difference in packing density amplifies to a 45.8% difference in forage $ value retained and fit into "space". A $8,306.00 difference in retained forage value. Net value of forage losses due to lower density = $1271.00
- …but you *may* still need to find a home for 4.9 lbs. DM/ $ft.^3$ you need as feed that did not fit into the "space". At $0.18 annualized capital cost per ft.3 = $2300.00.

Wasted silo "space" costs are additive to DM losses –twice the $ value!!

*Value of $35.00/ton haylage at 35% Dry Matter (DM), converted to 100% DM and expressed in pounds.

A CD containing all of the University of Wisconsin Bunker Silo/Pile decision making spreadsheets is available to all NYS Dairy Producers by contacting Heather Darrow at 607-255-4478 or hh96@cornell.edu.. The interface screens describe what the spreadsheet does, needed inputs and outputs.

Dr. Brian Holmes is author or co-author of all of these. He beat us to the draw when releasing his latest spreadsheet "Determining Value of Improved Silage Management" in May ('08). That was appreciated and led to the development of the other software participating producers clamored for; a simple means of reliably estimated silage inventory in bunkers and piles. That tool is the new web-based software named "SiloStor". The URL is: http://www.agmodels.com/clients/silostor/

Developed with NYFVI support by AgModels, LLC, this program has the power and storage capacity of a protected remote server and allows for continuous updating as users seek new features or encounter the occasional glitch. On the following page is a screen capture of the summary page. Other pages allow for updating data (entered as "feet missing from silo" on a given date), graphical view of rate of disappearance, editing silo parameters, etc. New features will be added without upsetting the simplicity of the interface.