Feed Management

A Key Ingredient in Livestock and Poultry Nutrient Management

Silage Management Considerations

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Disclaimer
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Introduction

This fact sheet has been developed to support the implementation of the Natural Resources Conservation Service Feed Management 592 Practice Standard. The Feed Management 592 Practice Standard was adopted by NRCS in 2003 as another tool to assist with addressing resource concerns on livestock and poultry operations. Feed management can assist with reducing the import of nutrients to the farm and reduce the excretion of nutrients in manure.

The Natural Resources Conservation Service has adopted a practice standard called Feed Management (592) and is defined as "managing the quantity of available nutrients fed to livestock and poultry for their intended purpose". The national version of the practice standard can be found in a companion fact sheet entitled "An Introduction to Natural Resources Feed Management Practice Standard 592". Please check in your own state for a state-specific version of the standard.

Regardless of the size of a dairy operation, producers know problems can occur in every silage program. This fact sheet describes possible causes and solutions for nine potential problems in managing silage in bunker silos, drive-over piles, and bags.

The nine potential problems include:

- High 'forage in' versus 'silage out' loss in bunker silos, drive-over piles, and silage bags
- Large variation in DM content and/or nutritional quality of the ensiled forage
- Missing the optimum harvest window for whole-plant corn
- High levels of butyric acid and ammonia-nitrogen, particularly in 'hay-crop' silage
- High levels of acetic acid in wet corn silage
- Aerobically unstable corn silage during feedout
- Excessive surface-spoiled silage in bunker silos and drive-over piles
- Poorly managed bagged silage
- Safety issues for bunker silos and drive-over piles.

Dairy producers should discuss these problems and solutions with everyone on their silage team, including their nutritionist and custom operator, as a reminder to implement the best possible silage management practices.

Four Excel spreadsheets to help producers make decisions about bacterial inoculants, packing density, and sealing strategies for bunker silos and drive-over piles are discussed.

High 'Forage In' versus 'Silage Out' Loss in Bunker Silos, Drive-over Piles, and Silage Bags

Solutions

- Select the right forage hybrid or variety.
- Harvest at the optimum stage of maturity and DM content.
- Use the correct size of bunker or pile, and do not over-fill bunkers or piles.
- Employ well-trained, experienced people, especially those who operate the forage harvester, pack tractor, or bagging machine. Provide training as needed.
- Apply the appropriate lactic acid bacterial (**LAB**) inoculant.
- Achieve a uniform packing density in bunkers and piles (a minimum of 15 lbs of DM per ft^3).
- Provide an effective seal to the surface of bunkers and piles and consider using double polyethylene sheets or an oxygen barrier (**OB**) film.
- Follow proper face management practices during the entire feedout period.
- Schedule regular meetings with your forage team.

Large Variation in DM Content and/or Nutritional Quality of the Ensiled Forage

Causes

- Interseeded crops that are not at the optimum stage of maturity at harvest.
- Multiple cuttings or multiple forages ensiled in the same silo.
- Delays in harvest activities because of a breakdown or shortage of machinery and equipment.
- Seasonal or daily weather that affects crop maturing and field-wilting rates.
- Variation among corn hybrids.

Solutions

▪ Use multiple silos and smaller silos that improve forage inventory control.

▪ Ensile only one cutting and/or variety of 'hay-crop', field-wilted forage per silo.

▪ Minimize the number of corn and/or sorghum hybrids per silo.

▪ Shorten the filling-time, but do not compromise packing density.

▪ Harvest during stable weather, especially for 'hay-crop' forages.

Missing the Optimum Harvest Window for Whole-plant Corn

Causes

▪ Harvest equipment capacity is inadequate and/or the crop matures in a narrow harvest window.

▪ Warm, dry weather can speed the maturing process and dry-down rate of the crop.

▪ Wet weather can keep harvesting equipment out of the field.

▪ Sometimes it is difficult to schedule the silage contractor.

Solutions:

▪ Plant multiple corn hybrids with different season lengths.

▪ Improve the communication between the dairy producer, crop grower, and silage contractor.

▪ Change harvest strategy, which might include kernel processing, shorter theoretical length of cut (**TLC**), or adding a pack tractor.

High Levels of Butyric Acid and Ammonia-nitrogen, particularly in 'Hay-crop' Silage

Causes

▪ The forage is ensiled too wet, and clostridia dominate the final fermentation process.

▪ Alfalfa and other legumes, which experience a rain event in the field after mowing, are at a higher risk because rain leaches soluble sugars from the forage.

Solutions

▪ Chop and ensile all forages at the correct DM content for the type and size of silo.

▪ Proper packing to achieve a minimum density of 15 lb of DM per ft^3 excludes oxygen and limits the loss of plant sugars during the aerobic phase (Visser, 2005; Holmes, 2006).

▪ Apply a homolactic LAB inoculant to all forages to ensure an efficient conversion of plant sugars to lactic acid.

▪ Do not contaminate the forage with soil or manure at harvest, and put the forage on a concrete or asphalt base.

▪ If it is not possible to control the DM content by wilting in the field, the addition of dry molasses, beet pulp, or ground grain can reduce the chance of a clostridial fermentation and the problems associated with butyric acid silages.

High Levels of Acetic Acid, particularly in wet Corn Silage

Causes and symptoms

▪ If the whole-plant has a low DM content, it is predisposed to a long, heterolactic fermentation.

▪ This silage has a strong 'vinegar' smell, and there will be a 1- to 2-foot layer of bright yellow, sour smelling silage near the floor of a bunker silo or drive-over pile.

Solutions

▪ Ensile all forages at the correct DM content, and especially not too wet.

▪ Apply a homolactic LAB inoculant to ensure an efficient conversion of plant sugar to lactic acid.

Aerobically Unstable Corn Silage during Feedout

Research has not explained why corn silages differ in their susceptibility to aerobic deterioration. Microbes, primarily lactate utilizing yeast, as well as forage and silage management practices contribute to aerobic stability of an individual corn silage. Nevertheless, there are several practical steps dairy producers need to be aware of, which can help minimize feedout problems.

Solutions: At harvest and filling time.

▪ Harvest at the correct stage of kernel maturity, and especially not too mature.

▪ Ensile at the correct DM content, and especially not too dry.

▪ In normal conditions, do not chop longer than ¾-inch TLC if the crop is processed or ½-inch, if not processed.

▪ Achieve a uniform packing density of at least 15 lbs of DM per ft^3.

▪ If aerobic stability continues to be a problem, consider using a LAB inoculant that contains the heterlactic bacteria, *Lactobacillus buchneri* (Kung et al., 2003).

Solutions: at feedout.

▪ Maintain a rapid progression through the silage during the entire feedout period.

▪ The feedout face should be a smooth surface that is perpendicular to the floor and sides in bunker or pile.

▪ Proper unloading technique includes shaving silage down the feedout face and never 'digging' the bucket into the bottom of the silage feedout face.

▪ Remove 6 to 12 inches per day in cold weather months; 12 to 18 inches per day in warm months.

- ✓ Feed from 'larger feedout faces' in cold weather months.
- ✓ Feed from 'smaller feedout faces' in warm weather months.

▪ Minimize the time corn silage stays 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.

▪ When building new silos, size them correctly to allow adequate feedout rates.

▪ Consider using a silage facer as an alternative to a front-end loader.

A 'Facer Cost Analysis' Excel spreadsheet by Holmes (2003) calculates the breakeven cost of a facer for silage removal compared to a front-end loader.

The breakeven cost of the facer, when converted to an annual cost, equals the sum of improvement in DM recovery value and additional labor, equipment, and fuel use costs. The labor, equipment, and fuel use could actually be savings if the facer operates at a faster rate than the front-end loader. The spreadsheet and a complete discussion of the topic are available on the UW-Extension Team Forage web site at: http://www.uwex.edu/ces/crops/uwforage/storage.htm.

Excessive Surface-spoiled Silage in Bunker Silos and Drive-over Piles

Solutions

▪ Achieve a uniform density (minimum of 12 to 14 lbs of DM per ft^3) within the top 3 ft of the silage surface.

▪ Shape all surfaces so water drains off the bunker or pile, and the back, front, and side slopes should not exceed a 3 to 1 slope.

▪ Seal the forage surface immediately after filling is finished.

▪ Two sheets of polyethylene or a single sheet of OB film is preferred to a single sheet of plastic (Berger and Bolsen, 2006; Bolsen and Bolsen, 2006b).

▪ Overlap the sheets that cover the forage surface by a minimum of 3 to 4 feet.

▪ Arrange plastic sheets so runoff water does not contact the silage.

▪ Sheets should reach 4 to 6 feet off the forage surface on the perimeter of a drive-over pile.

▪ Put uniform weight on the sheets over the entire surface of a bunker or pile, and double the weight placed on overlapping sheets.

- ✓ Bias-ply truck sidewall disks are the most common alternative to full-casing tires.
- ✓ Sandbags, filled with pea gravel, are an effective way to anchor the overlapping sheets, and sandbags provide a heavy, uniform weight at the interface of the sheets and bunker wall.
- ✓ Sidewall disks and sandbags can be stacked, and if placed on pallets, they can be moved easily and lifted to the top of a bunker wall when the silo is being sealed and lifted to the top of the feedout face when the cover is removed.
- ✓ A 6- to 12-inch layer of sand or soil or sandbags is an effective way to anchor sheets around the perimeter of drive-over piles.

▪ Prevent damage to the sheet or film during the entire storage period.

- ✓ Mow the area surrounding a bunker or pile and put up temporary fencing as safe guards against domesticated and wild animals.
- ✓ Store waste polyethylene and cover weighting material so it does not harbor vermin.
- ✓ Regular inspection and repair is recommended because extensive spoilage can develop quickly if air and water penetrate the silage mass.

▪ Discard all surface-spoiled silage because it has a significant negative effect on DM intake and nutrient digestibility (Whitlock et al., 2000; Bolsen, 2002).

▪ Full casing discarded tires were the standard for many years to anchor polyethylene sheets on bunker silos. These waste tires are cumbersome to handle, messy, and standing water in full casing tires can spread the West Nile virus, which is another reason to avoid using full casing tires on beef and dairy operations (Jones et al., 2004).

Poorly Managed Bagged Silage

The bag silo has become a popular storage system on many farms in the USA. While bagged silage requires specialized equipment, bagging machines can be rented or many silage custom operations provide them. Bags are also used to store extra silage when forage yields exceed the capacity of existing silo structures. Nevertheless, bagged silage is not trouble-free. Bolsen and Bolsen (2006a) surveyed 15 nutritionists, dairy producers, and silage contractors and asked, 'better bagged silage: what is important?'. Selected responses from participants are presented here.

Better bagged silage: what is important?

▪ Bags should be located on a well-drained, firm surface and preferably on concrete or asphalt.
- ✓ Keep bags out of the mud.
- ✓ Provide feeders easy access to all bags.

▪ Low silage DM densities are a problem in bags (Visser, 2005). A skilled bagging machine operator is essential to insure a consistent, uniform fill and achieve an acceptable density.

▪ Mark (paint) bags with a number, date, crop, farm/field, use description (i.e., which cattle to feed).

▪ Record the DM content of all forage going into a bag, especially field-wilted, hay-crop silage, and mark the location of potentially 'problematic silage' (i.e., too wet, too dry, too mature, etc.).

▪ Do not bag alfalfa 'too wet'. The DM target should always be 35 to 45 percent.

▪ Check all bags at least three times per week and mend/patch the punctures and holes.

▪ The silage removal rate at feedout must be sufficient to prevent the exposed silage from heating and spoiling, especially if multiple bags are open at same time.
- ✓ Caution: The first bags used in the 1970s had diameters of 8 to 9 feet, but some large, self-propelled bagging machines today use 12 to 14 feet diameter bags.
- ✓ Remove only enough plastic for silage needed daily.

▪ Monitor the DM content of all silages and make appropriate changes in the ration when DM content changes more than two percentage units.

▪ Remember: Good bagged silage is no accident; it takes sound management and attention to detail!

Safety Issues for Bunker Silos and Drive-over Piles: Major Hazards and Preventive Measures

Consistently protecting workers, livestock, equipment, and property at harvest, filling, and feeding does not occur without thought, preparation, and training (Murphy and Harshman, 2006).

▪ ***Tractor roll-over***

- ✓ Roll-over protective structures (**ROPS**) create a zone of protection around the tractor operator. When used with a seat belt, ROPS prevent the operator from being thrown from the protective zone and crushed by the tractor or equipment mounted on or drawn by the tractor.
- ✓ Install sighting rails on above ground walls. These rails indicate the location of the wall to the pack tractor operator but are not to hold an over-turning tractor.
- ✓ Form a progressive wedge of forage when filling bunkers or piles. The wedge provides a slope for packing, and a minimum slope of 3 to 1 reduces the risk of a tractor roll-over.
- ✓ Use low-clearance, wide front end tractors and add weights to the front and back of the tractors to improve stability.
- ✓ When two or more pack tractors are used, establish a driving procedure to prevent collisions.
- ✓ Raise the dump body only while the truck is on a rigid floor to prevent turnovers.

▪ ***Entangled in machinery***

- ✓ Keep machine guards and shields in place to protect the operator from an assortment of rotating shafts, chain and v-belt drives, gears and pulley wheels, and rotating knives on tractors, pull-type and self-propelled harvesters, unloading wagons, and feeding equipment.

▪ ***Run-over by machinery***

- ✓ Never allow people (especially children) in or near a bunker or pile during filling.
- ✓ Properly adjust rear view mirrors on all tractors and trucks.

▪ ***Fall from height***

- ✓ It is easy to slip on plastic when covering a bunker, especially in wet weather, so install guard rails on all above ground level walls.
- ✓ Use caution when removing plastic and tires, especially near the edge of the feeding face.
- ✓ Never stand on top of a silage overhang in bunkers and piles, as a person's weight can cause it to collapse.

▪ ***Crushed by an avalanche/collapsing silage***

- ✓ The number one factor contributing to injuries or deaths from silage avalanches is overfilled bunkers and drive-over piles!
- ✓ Do not fill higher than the unloading equipment can reach safely, and typically, an unloader can reach a height of 12 to 14 feet.

- ✓ Use proper unloading technique that includes shaving silage down the feeding face and never 'dig' the bucket into the bottom of the silage. Undercutting, a situation that is quite common when the unloader bucket cannot reach the top of an over-filled bunker or pile, creates an overhang of silage that can loosen and tumble to the floor.
- ✓ Never allow people to stand near the feeding face, and a rule-of-thumb is never being closer to the feeding face than three times its height.
- ✓ Fence the perimeter of bunkers and piles and post a sign, "Danger: Do Not Enter. Authorized Personnel Only".

▪ ***Complacency***

- ✓ Think safety first! Even the best employee can become frustrated with malfunctioning equipment and poor weather conditions and take a hazardous shortcut, or misjudge a situation and take a risky action (Murphy, 1994).

Achieving a Higher Silage DM Density in Bunker Silos and Drive-over Piles

A high DM density in the ensiled forage is important (Holmes, 2006). Why? First, density determines the porosity of the silage, which affects the rate at which air can enter the silage mass during the feedout phase. Second, achieving a higher density increases the storage capacity of a silo. Thus, a higher DM density typically decreases the annual storage cost per ton of crop by increasing the tons of crop that can be put in a given silo volume and decreasing the 'forage in' vs. 'silage out' loss that occurs during the fermentation, storage, and feedout periods.

Case Study Dairy. The Holmes-Muck Excel spreadsheet calculations for the average silage density in a drive-over pile of corn silage at a case study dairy are in **Table 1**. The actual 2003 pile of corn silage had a DM density of 11.5 lbs per ft^3 and an estimated silage DM recovery of 77.5% (i.e., a 22.5% 'shrink' loss).

The following changes were made for the 2004 corn silage: 1) the maximum pile height was lowered from 16 to 14 feet, 2) the forage delivery rate increased from 75 to 90 tons per hour, 3) the average forage DM content increased from 32 to 34%, 4) a second tractor was added to assist in packing, and 5) the estimated forage layer thickness decreased from 8 to 5 inches. These changes resulted in a predicted silage DM density of 15.8 lbs per ft^3. The estimated silage DM recovery was 85.0% (i.e., a 15.0% 'shrink' loss) for the 2004 silage, which was based on the data by Ruppel (1992).

Profitability of LAB inoculated Corn Silage for Lactating Dairy Cows

Dairy producers, dairy nutritionists, and custom silage operators are sometimes concerned about whether it is economical to use an LAB inoculant when making whole-plant corn silage. Presented in **Table 2** is an example from an Excel spreadsheet, which shows the profitability of inoculating whole-plant corn silage with LAB for lactating dairy cows. The dairy herd in this example had an average milk production of 75 lbs per cow per day and a ration DM intake of 52 lbs. The increase in net income with LAB-treated corn silage, calculated on a per cow per day and per cow per year basis, comes from improvements in both forage preservation and silage utilization. The additional 'cow days' per ton of crop ensiled from an increased silage recovery (1.5 percentage units) and an increased milk per cow per day (0.25 lbs) gave an added net income of 13.0¢ per cow per day and $39.53 per cow per year. The increase in net return per ton of whole-plant corn ensiled with an LAB inoculant was $5.73. The Excel spreadsheet is on the Kansas State University silage web site at: http://www.oznet.ksu.edu/pr_silage

Profitability of LAB inoculated Corn Silage for Growing Cattle

Presented in **Table 3** is an example from an Excel spreadsheet, which shows the profitability of inoculating corn silage with LAB for growing cattle. The cattle in this example had an average weight of 650 lbs, a DM intake of 2.62% of body weight, a ration DM intake to gain ratio of 17.0, and an average daily gain of 2.39 lbs. The cattle performance responses to LAB-treated corn silage were a 0.06 lb increase in avg. daily gain (2.39 vs. 2.45 lbs) and an improved ration DM to gain ratio of 0.15 (6.95 vs. 7.1). The DM recovery response was 1.5 percentage units for LAB-treated silage compared to the untreated silage (84.0 vs. 82.5). The gain per ton of 'as-fed' whole-plant corn ensiled was 92.0 lbs for the LAB-treated vs. 88.45 lbs for untreated corn silage, which was an increase of 3.55 lbs. With a cattle price of $1.20 per lb and a LAB cost of $0.75 per ton of crop ensiled, the net benefit per ton of crop ensiled was $3.51. The Excel spreadsheet is on the Kansas State University silage web site at: http://www.oznet.ksu.edu/pr_silage

Spreadsheet: Profitability of Sealing Bunker Silos and Drive-over Pile

An Excel spreadsheet to calculate the profitability of sealing corn silage and alfalfa haylage in bunker silos and drive-over piles was developed from research conducted at Kansas State University between 1990 to 1995 and equations published by Huck et al. (1997). The authors noted that about 75% of the total tons of corn and sorghum silage made in Kansas from 1994 to 1996 were not sealed, and the value of silage lost to surface spoilage was between 7 and 9 million dollars annually.

Presented in **Table 4** are examples from the spreadsheet. The profitability of properly sealing bunkers and piles with standard 5- or 6-mil plastic or an improved oxygen barrier film makes it clear that producers should pay close attention to the details of this 'highly troublesome' task. Further information about the improved OB film is at: *www.silostop.com*

Table 1. Spreadsheet calculations of the average silage densities in a drive-over pile of corn silage on a case study dairy (Intermediate calculations not shown). [1, 2]

Component	Actual: 2003 corn silage	Predicted: 2004 corn silage
Bunker silo wall height, ft (0 for drive-over pile)	**0**	**0**
Bunker silo maximum silage height, ft	**16**	**14**
Forage delivery rate to the pile, fresh tons / hr	**75**	**90**
Forage DM content, % (note: decimal)	**0.32**	**0.34**
Estimated forage packing layer thickness, inches	**8**	**5**
Tractor # 1 weight, lbs[3]	**35,000 (80)**	**35,000 (80)**
Tractor # 2 weight, lbs[3]	**0**	**35,000 (95)**
Estimated average DM density, lbs / ft[3]	11.5	15.8

[1]From B. J. Holmes, UW-Madison, and R. E. Muck, US Dairy Forage Research Center, Madison. Available at: http://www.uwex.edu/ces/crops/uwforage/storage.htm
[2]Numbers in **bold** are user inputs.
[3]Estimated packing time as a percent of filling time is in parenthesis.

Table 2. Profitability of LAB-treated corn silage for lactating dairy cows.[1]

Ration ingredient	DM intake, lb	DM, %	As-fed, lb / day	$ / lb	Feed cost, $ / day
Corn silage, other forage, and grain/supplement inputs:					
Corn silage	**15.0**	**33.3**	45.0	**0.0175**	0.79
Other silage/haylage	**9.0**	**45.0**	20.0	**0.030**	0.60
Other forage/hay	**4.0**	**88.0**	4.6	**0.060**	0.27
Grain/supplement	**24.0**	**88.0**	27.3	**0.095**	2.59
Total	52.0		96.9		4.25
Corn silage inventory and inoculant cost:					
Corn silage required / cow / year, ton					7.94
LAB cost / ton of crop ensiled, $					**0.75**

[1]Numbers in **bold** are user inputs.

Table 2 (cont.). Profitability of LAB-treated corn silage for lactating dairy cows.[1]

Component	Untreated corn silage		LAB corn silage
Preservation efficiency:			
Silage recovery, % of crop ensiled[2]	**85.0**	**(1.5)**	86.5
Silage recovered / ton of crop ensiled, lb	1,700		1,730
Amount of corn silage fed / cow per day, lb	45.0		45.0
Cow days / ton of crop ensiled	37.74		38.41
Extra cow days / ton of crop ensiled			0.67
Milk production / cow / day, lb			**75.0**
Milk gained / ton of crop ensiled, lb			49.9
Milk price, $ / lb			**0.135**
Increased milk value / ton of crop ensiled, $			6.74
Utilization efficiency:			
Increased milk / cow / day, lb			**0.25**
Increased milk value / ton of crop ensiled, $			1.30
Preservation + utilization efficiency:			
Extra milk value / ton of crop ensiled, $			8.04
Increased feed cost / extra cow day, $			3.46
Increased feed cost / ton of crop ensiled, $			2.31
Increase net return / ton of crop ensiled, $			5.73
Added cost of LAB: per cow / day, $			0.02
per cow / year, $			5.96
Added income as milk: per cow / day, $			0.15
per cow / year, $			45.53
Net benefit with LAB: per cow / day, $			0.13
per cow / year, $			39.53

[1]Numbers in **bold** are user inputs.
[2]Shown in parenthesis is the response to LAB inoculant expressed in percentage units.

Table 3. Profitability of LAB-treated corn silage for growing cattle.[1]

Ration ingredients	DM basis	Untreated ration	LAB Ration	Untreated ration	LAB response[2]	LAB Ration
	%	DM, %	DM, %	lb / day		lb / day
Corn silage	**87.5**	**0.333**	**0.333**	14.88		14.88
Grain or supplement	**12.5**	**0.90**	**0.90**	2.12		2.12
Total	100			17.0		17.0
Avg. cattle wt, lb	**650**					
Cattle price, $ / lb	**1.20**					
Avg daily gain, lb				2.39		2.45
DM intake, lb / day				**17.0**		17.0
Ration DM / lb of gain, lb				**7.1**	**- 0.15**	6.95
Silage / lb of gain, lb as-fed				18.7		18.3
DM recovery, % of the ensiled crop				**82.5**	**+ 1.5**	84.0
Gain / ton of as-fed crop ensiled, lb				88.45		92.0
Increased gain / ton of as-fed crop ensiled, lb				---		3.55
Value of the extra gain / ton of crop ensiled, $				---		4.26
Cost of LAB / ton of crop ensiled, $				---		**0.75**
Net benefit / ton of LAB-treated crop ensiled, $				---		3.51

[1]Numbers in **bold** are user inputs.
[2]From Bolsen et al. (1992).

Table 4. Profitability of sealing corn silage and alfalfa haylage in bunker silos and drive-over piles with standard 5- or 6-mil plastic and OB film.[1]

Inputs and calculations	Bunker 1 corn standard	Bunker 2 corn OB film	Bunker 3 alfalfa standard	Bunker 4 alfalfa OB film	Pile 1 alfalfa OB film
Silage value, $ / as-fed ton	**32.50**	**32.50**	**60.00**	**60.00**	**60.00**
Density in the top 3 ft, lb as-fed / ft^3	**39**	**39**	**35**	**35**	**40**
Silo width, ft	**40**	**40**	**40**	**40**	**100**
Silo length, ft	**120**	**120**	**120**	**120**	**250**
Silage lost in the original top 3 feet:					
unsealed, % of the crop ensiled	**50**	**50**	**50**	**50**	**50**
sealed, % of the crop ensiled	**22.5**[a]	**12.5**[a]	**20**[a]	**10**[a]	**10**[a]
Cost of covering sheet, ¢ / square ft	**4.0**	**10.0**	**4.0**	**10.0**	**10.0**
Silage in the original top 3 ft, ton	280	280	250	250	1,500
Value of silage in original top 3 ft, $	9,125	9,125	15,120	15,120	90,000
Value of silage lost if unsealed, $	4,565	4,565	7,560	7,560	45,000
Value of silage lost if sealed, $	2,055	1,140	3,025	1,510	9,000
Sealing cost, $	670	960	670	960	5,900
Net value of silage saved by sealing, $	1,840	2,460	3,860	5,090	30,100

[1]Numbers in **bold** are user inputs.
[a]Adapted from Bolsen and Bolsen (2006b).

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