MANAGING SILAGE
IN YOUR FEEDING PROGRAM

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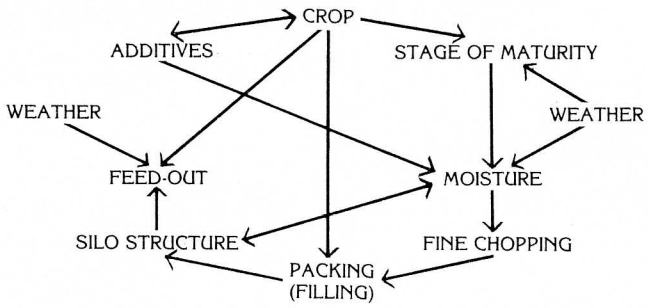
Silage is an important part of many successful beef cattle programs today. Amounts of total digestible nutrients (TDN) and beef produced per acre are usually greatest when forages are harvested and fed as silage.

But probably no other feedstuff used in cattle rations is so variable and inconsistent in "quality" as silage. Good silage just doesn't happen! It takes common sense, attention to details and sound MANAGEMENT.

Silage quality is affected by at least *nine* factors that are shown in Figure 1. These factors do not act independently of each other—they interact (as indicated by the arrows) to determine silage quality. I will briefly discuss these nine factors and how they affect silage.

Figure 1. FACTORS THAT AFFECT SILAGE QUALITY



THE CROP: Grow those crops that offer the greatest advantage agronomically in your area and that can produce the greatest amount of total digestible nutrients per acre. With few exceptions, good silage can be made from any crop grown in the U.S.

STAGE OF MATURITY: For "hay crops" (like grasses and legumes), selecting the "optimum" maturity to harvest for silage is often a compromise between increasing dry matter yield and decreasing digestibility as the crop matures. For "grain-containing" crops (like corn or sorghum), we normally want the kernel to be physiologically mature. The following recommendations may serve as guidelines:

Alfalfa—late bud to 1/10th bloom
Sorghum—soft-dough kernels
Corn—kernels fully dented
Wheat, Barley, Oats—soft-dough kernels
Perennial Grasses—prior to head emergence
Summer Annual Grasses—prior to head emergence

MOISTURE: I believe moisture content is the single most important factor affecting silage quality. Ensiling above 72-74% moisture can produce seepage, undesirable butyric acid, high fermentation losses and reduced intake of the silage by cattle. Ensiling below 50-55% moisture creates problems in eliminating air (poor compaction) and achieving sufficient fermentation and low pH.

When ensiling cereals (wheat, barley and oats) in the soft-dough, the 60-65% moisture range is of short duration—maybe only a few days. So here are a few ways to overcome this problem: (1) Start harvesting a few days early, (2) be prepared to add water near the end of the harvest, (3) plant two or more cereals that do not ripen at the same time, i.e., winter wheat and spring oats—so when and if the first crop gets too dry, begin harvesting and blending the wetter second crop with the drier first crop.

FINE CHOPPING: Common sense and attention to details are important! Sharp cutter knives, close adjustment of knives and shear bar, and the possible use of recutter screens are all daily management decisions during silage harvest. How fine (or coarse) should we chop silage? Theoretically, ¼-½ inch is the most commonly recommended length, but this will vary with the crop, power requirement, tonnage per hour, etc. Hollow-strawed cereals need to be chopped finer than solid-stemmed corn or sorghum, and over-wilted legumes or grasses (below 50% moisture) need to be chopped finer than ideal-wilted legumes or grasses (60-65% moisture).

Crops that are chopped too coarse present two big problems to the cattleman: (1) More air will be trapped when it is ensiled and (2) more silage will be refused at the feed bunk when it is fed. Grain sorghum stover is a good example—thousands of tons are ensiled each fall in Kansas. Its high moisture content (60-70%) makes ensiling an ideal harvest-storage method. But sorghum stover is a bulky forage, contains no grain and is high in fiber, so "fine chopping" is really important.

PACKING (FILLING): Packing (and filling) the silo should be as rapid as possible! Try to avoid delays and have your equipment in good repair before the silage season.

A good practice is to fill trench or bunker silos so a minimum surface area of the crop is exposed to the air. Do not fill a trench or bunker layer by layer the entire length of the silo. Also "seal" the surface after filling—this keeps air, rain and snow out and reduces spoilage losses.

SILO STRUCTURE: The type of silo does affect silage quality—and does affect the amount of nutrients preserved. It is not uncommon for silage-in vs. silage-out losses to be as high as 15-20%—and most cattlemen ignore it! Why? It is not easy to see or measure.

Use the following guidelines for silage losses:

Silo Type	Dry Matter Loss
Oxygen-Limiting	3-8 %
Concrete Upright	5-15%
Trench or Bunker	12-25%
Open Stack	20-40%

But remember: Sound MANAGEMENT is the only way to keep these losses to a minimum.

FEED-OUT: It is one thing to make good quality silage and another to keep it fresh on feed-out. There are no set rules on minimum or maximum rates of removal, but the time silage is exposed to the air should be as short as possible. This is particularly true in warm weather when conditions are favorable for growth of mold and other spoilage organisms.

WEATHER: Weather interacts with most of the factors I have discussed. Rainy weather can delay harvest and prevent crops from being ensiled at an optimum stage of maturity. This is more often a problem with legumes, grasses, summer annuals and cereals than with corn or sorghum.

Unfavorable drying conditions can lengthen time required for field-wilting; but hot dry conditions can cause over-wilting and crops being ensiled too low in moisture.

ADDITIVES: There are four general categories of silage additives: (1) Acids for direct acidification, (2) preservatives [sterilants and fatty acids], (3) feedstuffs [molasses, grain, non-protein nitrogen, etc.] and (4) fermentation aids [enzymes, innoculants, antioxidants, etc.]. Regardless of the additive used, its benefit to silage must offset its cost. And remember: No additive should be used as a "crutch" for poor MANAGEMENT.

After silage is *made right,* it must be *fed right* for efficient and profitable beef production. The key here is to feed *nutritionally balanced* rations!

Formulating balanced silage and/or hay rations is not difficult if you know the nutrient requirements of your cattle and the nutrient content of your forage. A good reference for nutrient requirements is the NRC (1976).*

It's a good practice to obtain a "proximate analysis" of your forage. This fractions the feed into water, crude protein, crude fiber, ether extract, ash and nitrogen-free extract. Total digestible nutrients (TDN) can be calculated mathematically from values determined for these six fractions.

Though the test has some limitations, it is widely available from various testing laboratories. Cost varies considerably among laboratories, but you should be able to have a complete proximate analysis run for $20-$30 per sample. If you are unable to locate a testing service in your area, contact your local university extension agent, who is sure to know the name of nearby testing services.

Poor sampling technique may lead to greater error than using average analysis in NRC. To obtain a representative silage sample, the National Silo Assn.** recommends these procedures: "When testing silage, allow at least 30 days after filling silos before sampling. In silos that are opened, take double handfuls of material from several locations on the new face. If sampling from the unloader of an upright silo, take the samples near the end of its operation. Mix samples well and retain about 2 quarts for analysis . . . handle the sample to insure that it does not become contaminated or deteriorate before it is tested. Plastic bags are ideal containers for silage samples. Milk cartons or insulated paper bags can be used as outer containers for shipping, or some laboratories may provide their own sample bags.

"To prevent moisture loss, seal the container immediately. If the sample is wet, freeze it to prevent deterioration. Mail samples immediately."

Silages will work in all cattle feeding programs but are best suited for breeding-age cattle and for growing bulls, steers or heifers.

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*NRC, 1976. NUTRIENT REQUIREMENTS OF DOMESTIC ANIMALS. No. 4, "Nutrient Requirements of Beef Cattle." National Academy of Science, 2101 Constitution Ave. Northwest, Washington, D.C.

**SILAGE...AND BEST-COST LIVESTOCK FEEDING PROGRAMS—1979. National Silo Assn., 2310 Falls Ave., Suite 2, Waterloo, Iowa 50701.

For the beef cow, we want to meet her TDN and protein requirements throughout her 12-month reproductive cycle (see Table1).

Table 1. BEEF COW 12-MONTH REPRODUCTIVE CYCLE

Phase 1 Calving	Phase 2 Breeding	Phase 3 Weaning	Phase 4
lactation	lactation and early gestation	mid-gestation	late gestation
85 days	120 days	110 days	50 days

Table 2 shows how to balance for energy and protein in a corn silage ration for phases 1 and 3.

First, balance for TDN:

Line a—Obtain the TDN required.

Line b—Calculate the pounds of corn silage dry matter (DM) needed by dividing the pounds of TDN required by the percent TDN in the corn silage. (Example for phase 1: 12.0 ÷ .7 = 17.1 lb.)

Line c—Calculate the pounds of "wet" corn silage needed by dividing the pounds of corn silage DM by the percent DM in the corn silage. (Example for phase 1: 17.1 ÷ .36 = 47.5 lb.)

Second, balance for crude protein (CP):

Line d—Obtain the CP requirement.

Line e—Calculate the pounds of CP supplied by the corn silage by multiplying the pounds of corn silage DM fed (line b) by the percent CP in the corn silage. (Example for phase 1: 17.1 × 0.075 = 1.3 lb.)

Line f—Calculate the CP deficiency by subtracting the pounds of CP supplied on line e from the CP requirement on line d. (Example for phase 1: 2.0 - 1.3 = 0.7 lb.)

Line g—Calculate the pounds of CP supplement needed by dividing the pounds of CP deficiency by the percent CP in the supplement. (Example for phase 1: 0.7 ÷ .35 = 2.0 lb.)

In this example a commercial protein supplement was used, but many cattlemen who have a legume (like alfalfa hay or silage) can use it in place of a high-CP supplement.

Most beef cows also will require supplemental minerals (i.e., phosphorus and salt) and vitamin A. These are commonly provided in a box on a free-choice basis.

Table. 2. FEEDING THE BEEF COW WITH CORN SILAGE

1,000-Lb. Cow	Phase 1	Phase 3
a. TDN required, lb./day	12.0	8.0
Corn Silage Needed:[1]		
b. lb. of silage DM/day	17.1	11.4
c. lb. of wet silage/day	47.5	31.7
CP Supplement Needed:[2]		
d. CP required, lb./day	2.0	0.9
e. CP supplied by corn silage, lb./day	1.3	0.9
f. CP deficiency, lb./day	0.7	none
g. lb. of protein supplement/day	2.0	none
h. Balanced ration	47.5 lb. corn silage + 2.0 lb. protein supplement	31.7 lb. corn silage

[1]*Assume the corn silage is 70% TDN, 7.5% CP and 36% DM.*
[2]*Assume the CP supplement is 35% CP.*

In a large silo, it is not uncommon to have the same crop ensiled over a wide range of moistures. For all cattle feeding programs (but especially beef cows), adjustments must be made in the amount of wet silage fed as moisture content changes. Cows in mid-gestation (phase 3) need about 32 lb. of 36% DM corn silage to meet their TDN requirement (Table 2). This changes to about 38 lb. of 30% DM corn silage (11.4 ÷ .30 = 38.0 lb.) and about 27 lb. of 42% DM corn silage (11.4 ÷ .42 = 27.0 lb.). So a cattleman provides energy his cows do not need if the silage changes from 30% to 42% DM and he fails to decrease the amount fed. On the other hand, he does not provide his cows with enough energy if the silage changes from 42% to 30% DM and he fails to increase the amount fed.

In growing rations for bulls, steers or heifers, silage is expected to provide the major portion of the energy. Table 3 ranks several common silages based on their energy content.

Table 3. ENERGY VALUE OF SILAGES FOR GROWING BULLS, STEERS OR HEIFERS

	Relative Energy Value (corn silage = 100)	TDN (%)
Corn Silage	100	65-70
Ear Corn Silage	110-120	72-75
Sorghum Head Silage	110-120	72-75
Barley Silage	95-100	62-66
Wheat Silage	80-85	58-62
Oat Silage	70-80	55-60
Alfalfa Silage	65-80	54-62
Alfalfa-Grass Silage	60-70	52-60
Sudan Grass Silage	65-85	54-60
Sorghum Stover Silage	60-65	50-55
Cornstalk Silage	50-60	45-50

Typical daily gains for steers or heifers fed high-silage rations are shown in Table 4.

Table 4. GAINS FOR STEERS OR HEIFERS FED HIGH-SILAGE RATIONS

	Average Daily Gain (lb.)
Corn Silage	1.75-2.25
Alfalfa Silage	1.25-1.75
Sorghum Stover Silage	0.75-1.25

These three silages make excellent growing rations—but each needs to be nutritionally balanced.

Corn silage needs supplemental crude protein. How much protein will depend on the protein content of the corn silage, the amount of silage consumed and the weight of the bulls, steers or heifers. Most growing rations for cattle weighing 450-750 lb. should contain 11-13% crude protein. Steers weighing 600 lb. and consuming 12 lb. of corn silage DM that is 8% crude protein will require 0.5-0.75 lb. of additional protein in the ration. It takes about 1.5 lb. of soybean meal or 2 lb. of a 32% commercial protein supplement to balance the protein in the ration.

A good quality alfalfa hay or silage will contain 18-20% protein—far in excess of the protein requirement—but its TDN content will not produce gains equal to corn silage. Here a good growing ration is one that combines the high-protein alfalfa hay or silage with a high-energy grain or silage. A ration containing 40% alfalfa hay or silage and 60% corn silage would be balanced for protein and provide enough energy for rapid and efficient gains.

In addition to energy or TDN and protein, most silage growing rations need supplemental calcium, phosphorus, salt, trace minerals and vitamin A. These are usually added to a supplement or offered free-choice in a separate feeder.

Sorghum stover and other crop aftermath make palatable silages that can be used in many cattle feeding programs today. These silages are low in both energy or TDN and protein; therefore, they work best in beef cow rations. Sorghum stover or cornstalk silages can often lower the cost of winter rations by providing all the energy needed for beef cows during mid-gestation (phase 3). Crop aftermath also can be combined with grain or high-protein legume hay or silage for efficient and economical growing rations. For the 600-lb. steer, a ration that is 50% sorghum stover silage and 50% alfalfa hay or silage is balanced for protein and has enough energy to produce about 1.25 lb. daily gain.

In every cattle feeding program, keeping fresh palatable feed in the bunk is important and requires good judgment. Here are four important points to remember:

1. When silage is in the ration, make adjustments for changes in silage moisture. As moisture increases, cattle will clean up silage in a shorter time, so increase the amount fed; as moisture decreases, silage will build up in the bunk, so decrease the amount fed.
2. Avoid using heated moldy feed ingredients (especially silage).
3. Clean out the bunks regularly to prevent build-up of spoiled feed.
4. Inspect the bunks at the same time each day to determine the amount of ration to be fed.