Judging Crop Quality, Part II: Score Sheets for Evaluating Haylage and Corn Silage

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Abstract

Evaluating haylage and corn (*Zea mays* L.) silage samples relative to their ideal forms and their feeding value for milk or meat production is an integral component of the Forage Crop Production course offered each semester at the University of Wisconsin River Falls (UW-RF). Students apply the forage quality concepts and hands-on evaluation covered in the class by judging haylage and corn silage samples in one of two annual crop contest-show events. Expanded and more functional score sheets than those initially available have been developed over a 30-year period for haylage and corn silage to better discriminate among contest entries. Objectives also included developing score sheets that were descriptive, logically organized, and easy to understand even by students having only a limited knowledge of plant characteristics and lacking experience with silages. The score sheets thus function as a learning tool helping students understand the relationship between haylage/silage characteristics and quality for feeding livestock. Haylage score sheet point categories include maturity, leafiness, color, odor, moisture, and antiquality penalties. The corn silage score sheet substitutes grain content and development for forage maturity and leafiness categories. The score sheets enable students to use visual, olfactory, and touch senses to systematically evaluate the silage samples by following a descriptive list and awarding points from a suggested point range for each characteristic. The completed sheets also provide a documented explanation to contest entrants and interested crops show observers regarding sample scoring and placement. This paper describes the general contest and judging procedures, the score sheets used, and the forage quality concepts incorporated into them as well as the rationale involved.

Introduction

Legume (*Leguminosae*) and grass (*Graminae*) forage harvested and stored as low-moisture (40-70%) silage is commonly called haylage. Corn (*Zea mays* L.) is a very popular traditional silage crop in dairy and

livestock production areas. Sorghum (*Sorghum bicolor* (L.) Moench) and small grain crops such as oats (*Avena sativa* L.) or barley (*Hordeum vulgare* L.) also can be ensiled. Evaluating silage materials for feeding value is just as important and useful as it is for hay. Wet chemistry and near infrared reflectance spectroscopy techniques exist for analyzing silage crops for feeding value as they do for hay, but they also may not be available or practical for use at times when quality evaluations are needed. Two annual crop contest-shows, one in fall and one in spring, are held at the University of Wisconsin-River Falls (UW-RF) (Greub and Cosgrove, 2006) in which entries judged by the Forage Crop Production class include haylage and corn silage. The initially available score sheets (Brickbauer et al., 1964) lacked sufficient descriptive detail and point discrimination to prevent or minimize numerous ties in the placings.

The revised and expanded score sheets presented in this paper were developed to provide a more systematic, easily understood, and yet scientifically guided approach for students to judge these products for their feeding value using only visual, olfactory, and touch senses. The score sheets also function as a hands-on learning tool in the Forage Crop Production lab allowing students to apply their understanding of haylage and corn silage characteristics that affect forage quality as covered in the lecture portion of the course. Effectively using these score sheets for judging does require having at least a basic knowledge of legume and grass plant leaf, stem, and inflorescence characteristics; being able to recognize the commonly used forage species; and perhaps being familiar with a few common forage crop weeds. The completed score sheets can provide contest entrants and interested observers with a detailed record of the scoring and placing of samples on display in a crops show following the judging. Contest rules require sample sizes of four quarts (approximately four liters) or more. The materials for both classes must be chopped and have undergone

Silage Quality Factors

Silages are preserved by the anaerobic fermentation of carbohydrates into organic acids, especially lactic and to a lesser degree, acetic and propionic (Collins and Owens, 2003). The acids reduce the pH of the silage mass to a range of about 3.8 to 4.5 which stops any further microbial activity and effectively preserves the silage as long as the anaerobic environment is maintained. Chopping (although not abso-

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lutely necessary for ensiling some materials), packing the material tightly to exclude air, and storing in an airtight structure or package are all essential for successful ensiling. Maturity and leafiness-steminess are just as important in haylage quality and for the same reasons as they are in hay quality (Buxton et al., 1985). In corn silage, however, the grain content becomes the most important characteristic because it is the major source of feed nutrients. In addition, the conditions that exist during fermentation and storage of silage can significantly affect the final product and thus the feeding value. Odor is evaluated because it is a useful indicator of proper or improper ensiling and storage conditions. Moisture is also included because it can influence fermentation and silage quality. A weeds, trash, and foreign material penalty section similar to that used for hay is included for both haylage and corn silage.

We elected to develop only one score sheet class for haylage and provide for flexibility in its use to accommodate in a general way the more specific grass and legume species characterizations that were incorporated into the four different hay score sheets (Greub and Cosgrove, 2006). For example, the higher neutral detergent fiber (NDF) level and slower rate of digestibility of grass hay compared with legume hay at equivalent stages of maturity (Collins and Fritz, 2003) is dealt with in haylage by estimating the proportion of grass in a sample as low, medium, or high and deducting penalty points accordingly.

Preparing Students for Judging the Contests.

Preparation for contest judging by the Forage Crop Production (Crops 263, 3 credits) class involves one or more lectures on forage quality and one two-hour laboratory period in which students inspect and characterize haylage and corn silage samples of varying quality. They practice judging samples of both crops using the score sheets and compare their results with those given by the instructor. An inventory of haylage and corn silage samples is maintained by subsampling and freezing suitable entries from previous contests and at times adding samples from silages being used at the university laboratory farm or other sources. Students work as a team judging the samples in either the haylage or corn silage class. As with hay, it can be helpful to look over all the entries in a class initially to get an impression of the range of visual characteristics represented. Judging haylage is considerably more difficult than judging hay because of the chopped plant material. Students with keen observation skills and a dedication to thoroughness and accuracy in their work generally do the best job of judging haylage samples.

Haylage Score Sheet

The Haylage Score Sheet is shown in Figure 1.

Stage of Harvest (Maturity)

Maturity indicators in haylage are the same as those described for hay (Greub and Cosgrove, 2006). However, the chopped haylage makes it more difficult to precisely determine stage of maturity, identify legume and grass species, determine if a sample is from a first cutting or a later cutting, and estimate the relative proportion of legume vs. grass in mixed samples. The first step in determining maturity should be finding and examining shoot tips for buds, inflorescence parts, or seed-bearing structures. Large stem diameters and faded leaf color can help confirm, but should not be used solely to determine advanced maturity stages. The Haylage Score Sheet lists legume and grass maturity stage descriptions side by side with no separate listing of point values for each. If there are differences in the maturity stages of legume and grass within a mixed sample, a footnote indicates that the point value assigned should be weighted for the relative proportion of each in the sample. For example, for an alfalfa (*Medicago sativa* L.)-orchardgrass (*Dactylis glomorata* L.) sample that is about two-thirds legume and one-third grass with the legume in the mid- to late-bud stage (25 to 26 points) and the grass in the early seed stage (18 to 21 points), a compromise point score of 24 could be given for maturity.

First-cutting haylage containing perennial cool-season grasses may have inflorescence parts present whereas second or subsequent cuttings will not unless the grass is timothy or weed species such as foxtails (*Setaria* spp.). Bermudagrass [*Cynodon dactylon* (L.) Pers.] heads also may appear in cuttings other than the first in southern areas (Collins and Fritz, 2003). Later cuttings of legume-grass mixtures not containing grass heads should be scored using the higher end of the point score ranges to reflect the better quality (Greub and Cosgrove, 2006).

Leafiness-Steminess

The superior quality of leaves compared with stems (Buxton et al., 1985) makes it imperative that samples be examined carefully for scoring this category. The difficulty is compounded by the chopping and mixing of plant parts. The relative amounts of leaf vs. stem material is the most obvious characteristic to examine, but stem piece diameters also should be considered. Sometimes a direct visual comparison between two or more similar samples can be helpful in establishing a hierarchy for assigning points. If there are differences in the leafiness-steminess between two types of species in a mixture, the score should be weighted to reflect the condition of the species making up the greatest proportion of the forage mass.

Color

Color variations in haylage often are less pronounced than in hay and only 15 points are allotted to this category. Haylages that otherwise appear to be well-preserved may exhibit a range of color due to species, weathering, or maturity. Properly fermented alfalfa haylage will normally have a dark greenish or slightly yellowish-green color. A bright green color usually indicates that it has not yet fermented or that possibly a preservative may have been used that caused natural fermentation to be bypassed. It is normal for red clover (*Trifolium pratense* L.) leaves to turn very dark, almost black, during fermentation. A tannish-brown color coupled with steminess often indicates weathering and bleaching in the field prior to chopping and ensiling. A yellowish-tan or brownish color is often characteristic of maturing grasses. Dark brown or black haylage coupled with a burnt or carmelized odor indicates excessive heating. A black color along with a wet and slimy texture and a foul odor indicates excessive moisture and improper fermentation. Gray or white colors, often seen in combination with clumping, indicate mold.

Odor

Odor is a very useful characteristic in evaluating silage preservation and is allotted 20 points. Lactic acid is the predominant acid produced under the anaerobic conditions in properly fermented silage and has only a very slight, pleasant odor. The presence of very noticeable odors such as acetic, fruity, or alcoholic, even though not unpleasant, indicates a less-than-ideal fermentation process.; however, the haylage may have preserved well because it was kept in a sealed, anaerobic environment. Inadequate fermentation and the resulting higher pH levels can allow proliferation of undesirable bacteria such as *Clostridia* spp. which convert lactic acid to foul smelling butyric acid with an accompanying loss of energy and reduced palatability (Collins and Owens, 2003: Pitt, 1990). Bad odors also result from the heating and spoilage that occurs when silage remains in a prolonged aerobic condition either initially or at feedout. Excessively wet haylage, above 70% moisture, may promote activity of proteolytic bacteria which produce ammonia and other foul-smelling products.

Heat-damaged haylage often has a pleasant caramel or tobacco-like odor and is readily eaten by livestock. Heating is usually caused by inadequate packing and incomplete exclusion of oxygen. If this condition is excessive or prolonged, it promotes the Maillard reaction which causes protein molecules in the forage to combine with carbohydrates and become unavailable to the animal thus reducing the feeding value (Collins and Owens, 2003).

Moisture

Forage crops made into haylage are almost always cut and then wilted in the field for several hours before being chopped. The field wilting reduces the moisture level from the 75-88% range of the standing crop to the 50-70% range better suited for proper fermentation and storage. Silages can preserve well under a wide range of moisture levels, especially in oxygen-limiting silos; therefore, this category is allocated only 10 points. A moisture level of 50-60% in haylage is ideal to allow for proper fermentation, a high level of palatability, and a high dry matter intake by livestock. Yet, in sealed, oxygen-limiting silo structures good preservation often can be achieved at moisture levels down to 40% or even less; thus, one may see relatively dry samples that are well preserved, but decreased palatability may now be a factor. Haylage in the 60-70% moisture range usually preserves well but dry matter intake may be reduced by the extra moisture. High moisture levels above 70% can cause leaching and loss of nutrient-containing liquids, especially from tower silos, as well as improper fermentation. A quick and easy test for proper moisture in haylage can be performed by taking a large handful and squeezing it hard with both hands. If liquid is expressed from the sample, it is above the ideal moisture level. Releasing the pressure suddenly on a squeezed sample in the ideal moisture range should allow the compressed haylage to slowly spring back to its precompressed state. If it springs back rapidly or falls apart upon being released it is too dry.

Anti-quality Penalties

Anti-quality penalties for haylage include the length of cut, grass content, disease and insect damage, nutrient deficiency symptoms, and weeds or foreign material in the hay. The length of cut in chopped forage becomes important because an excessive proportion of particles shorter than 0.95 cm (3/8 inch) is undesirable in the rations of ruminant livestock. It can cause serious physical problems such as a displaced abomasum in the digestive system, and it also reduces the butterfat percentage in the milk of dairy cows (Delorit et al., 1984; National Research Council, 2001). At least 20% of haylage particles should be about 2.54 cm (1 inch) or more in length (Pitt, 1990). Excessive amounts of chopped or shredded material greater than 3.81 cm (1½ inches) long may not detract from animal performance but can make it more difficult to get good packing and complete exclusion of air when ensiling and result in poor preservation. It also can simply be considered as a characteristic of less-than-ideal haylage. Here is where the possible inferiority of grasses compared with legumes for dairy cows as described above can be penalized using the suggested penalty point ranges for varying proportions of grass in the forage. Alternatively, this feature of the score sheet can be ignored if one does not wish to differentiate haylage samples on this basis.

The Weeds, Trash, and Other Foreign Material penalty section is applied here as in the hay score sheets (Greub and Cosgrove, 2006). Careful examination and some knowledge of weed species morphology will be necessary to fully assess contamination in haylage samples.

Corn Silage Score Sheet

The Corn Silage Score Sheet is shown in Figure 2.

Grain Content and Maturity

The grain component accounts for the greatest feeding value of corn silage. This also would be true for sorghum or other grain-crop silage. A high-yielding, mature corn silage crop produces over 50% of the total harvested dry matter as grain (Lauer, 2005). The score sheet allocates 40 of the 100 total points to the grain component. In addition to the relative quantity, the maturity of the grain becomes important. When a black layer has formed at the base of the kernel it is physiologically mature and has its full compliment of starch, protein, and oil stored within. Thus, the feeding value is at its potential maximum. Immature kernels will have no black layer and will contain semi-liquid or milky endosperm. The milk line or interface between the solid and liquid endosperm materials is also a good indicator of kernel maturity. As this line approaches the base of the kernel the endosperm is now largely in the solid form. Corn is usually considered to be in an ideal stage of maturity for silage harvest when the milk line has progressed two-thirds of the way to the kernel base (Collins and Owens, 2003). In some silage samples, however, it may be difficult to determine exactly how far the milk line has progressed because the chopping process usually ruptures the immature kernels spilling out the liquid and semi-liquid endosperm leaving behind a partially empty or completely empty pericarp. Fermentation also somewhat obscures the milk line.

The grain score can be adjusted to reflect both quantity and maturity on the score sheet. For example, if a silage sample has a medium grain content and mature kernels, it should receive at or near the high end of the point range for medium grain, 34 points. If the grain is mostly immature it should score at or near the low end of the point range, 28 points.

Kernels that are mature and relatively dry at time of harvest may pass through an animal's digestive tract largely intact even after undergoing fermentation. To reduce this nutrient loss, a treatment known as "processing" is becoming more commonly used when harvesting corn silage. Processing involves an additional step during harvest in which the chopped corn is subjected to further crushing action which fractures or shatters mature kernels and can reduce the starchy endosperm to small white and yellow granules more or less uniformly distributed throughout the silage. The cob pieces are likewise broken up by processing. Processing increases the difficulty of evaluating the grain content and determining the exact maturity stage of the grain. We have added a parallel column of descriptions and points to the grain-scoring section of the score sheet for processed samples. If the grain was physiologically mature, some black layers may still be evident, perhaps attached to remnants of the kernel pericarps. The processed grain content will have to be estimated based on the relative amount of the shattered white and yellow starch material in the sample. If processed silage is likely to make up a significant proportion of entries in a contest, it may be desirable to create a separate class for it.

Figure 1.

HAYLAGE SCORE SHEET
Univ. of Wisconsin – River Falls

[ ] DISQUALIFIED
[ ] Insufficient quantity
[ ] Does not meet class description

Must Be Chopped and Fermented

Sample Identification: __________

Date: __________

Contest/Event: __________

Judge(s): __________

A. Stage of Harvest (Maturity) — Legume	Grass	30 points*	Score
1. Prebud	Early jointing	30-29	
2. Early - mid-bud	Jointed, preheading	28-27	
3. Mid - late bud	Heads emerging	26-25	
4. First flower	Headed, pollen shedding	24-22	____
5. Early bloom (10-30%)	Early seed stage	21-18	
6. Mid-bloom (40o-60%)	Mid-seed stage	17-14	
7. Late bloom (70-100%)	Mature seed stage	13-10	
8. Seed stage	Seed shattering	9-5	

*If legume and grass at different maturities, compromise score in relationship to the proportion of grass in the sample.

B. Leafiness - Steminess	25 points*	
1. Very leafy, Stems fine or short	25-24	
2. Leafy, stems fine	23-21	
3. Leafy, stems medium	16-12	____
5. Slightly stemmy, few or some leaves lost	20-17**	
6. Stemmy, many leaves lost	16-12	
7. Very stemmy, most leaves	11-4	

*If legume and grass differ in these characteristics, compromise score according to the proportion of grass in the sample.
** Intentional point range

C. Color	15 points	
1. Greenish yellow, except well-preserved red clover silage usually will have a darker, almost blackish color	15-13	
2. Brownish-yellow, slightly weather-bleached or otherwise faded color but still well-preserved	12-10	
3. Moderate brownish or blackish color due to heat damage or improper preservation; moderate loss of color due to weathering, insect or disease damage; white color due to extensive mold.	9-6	____
4. Undesirable - dark brown or black due to heat damage or improper fermentation; severely weathered and bleached.	5-0	

D. Odor	20 points	
1. Very light, barely perceptible, pleasant odor	20-19	
2. A very definite, pleasant odor, not undesirable or indicative of spoilage or improper fermentation	18-16	
3. Acceptable, but having a definite fruity, yeasty, or musty quality; slight burnt odor, or other noticeable odor	15-10	____
4. Undesirable - definite burnt odor indicating excessive heating; strong sour, putrid, or foul odor indicating improper fermentation; very musty odor accompanied by excessive mold	9-0	

E. Moisture	10 points	
1. No free water can be squeezed out of sample; springs back slowly when squeezed and released; not overly dry so as to reduce palatability; well preserved	10	
2. Slightly too dry for best palatability, no heat damage or mold, springs back rapidly when squeezed and released	9-7	
3. Excess water can be squeezed out of sample, but otherwise well preserved.	7-5	____
4. Excessively dry with brownish color and slight burnt odor or a light mold; won't hold shape at all when squeezed and released	5-3	
5. Slimy or soggy with dark color and bad odor; or very dry with strong burnt odor; or prevalent mold	3-0	

TOTAL POINTS (A+B+C+D+E) Max. = 100 ____

F. Antiquality Penalties	Points Off	
1. Chopped too fine: more than 20% of material less than 0.95 cm (3/8") in length adversely affecting digestive system and/or butterfat test	0-10	____
2. Too Coarse: more than 20% of material 3.81 cm (1 1/2") or more in length.	0-5	____
4. Leaf disease or insect damage	0-5	____
3. Grass component, generally lowers quality compared with legume (Optional)		
Light grass, 0-30%	0-3	____
Medium grass, 40-60%	4-6	____
Heavy grass, 70-100%	7-9	____
5. Other __________	0-4	____

G. Weeds, Trash, and Other Foreign Material
Nonpoisonous or noninjurious: one point for each 1% of haylage mass ____
Poisonous or injurious: three points for each 1% of haylage mass ____

TOTAL PENALTIES (F+G) = ____

PLACING ________ **FINAL SCORE (Total – Penalties)** ____

Color

As with haylage, color can be helpful in evaluating corn silage and is allocated 20 points. The normal color of mature corn silage properly fermented usually is a yellowish-tan with a tinge of green. If the corn plants were in a totally green state when harvested, the silage will have a noticeable greenish color. In contrast, tannish and whitish colors indicate that the corn was harvested after the plants were frozen and killed, had matured and died naturally, or suffered from the effects of severe drought. Color also provides information regarding fermentation and storage conditions. Dark brown or black color can indicate heat damage sometimes found in excessively dry, inadequately sealed, or improperly fermented silage. Pink-colored mold also may be found in addition to gray and white types in corn silage.

Odor

Odor, with 28 points on the score sheet, is an important characteristic indicating how well desirable anaerobic fermentation and storage conditions prevailed. The faint, pleasant odor of lactic acid should be the only odor present. Acetic, fruity, and alcoholic odors, although perhaps not unpleasant, are evidence of less-than-ideal conditions in the ensiling process in corn silage as they are in haylage. Butyric acid or ammonia formation will cause foul, unpleasant odors and indicate a reduced quality product. Heat damage in corn silage also causes a tobacco-like or caramel odor along with a dark color. It has the same potentially adverse effects on the feeding value as in haylage.

Moisture

Moisture is allotted only 12 points because, as with haylage, there can be a relatively wide range in corn silage moisture content with little adverse affect on ensiling, storage, and feeding value so long as anaerobic conditions are maintained. Silage harvested from corn at or near physiological maturity under normal climatic conditions will usually be in the range of 60% to 70% moisture, ideal for fermentation and preservation. Fully mature and naturally senescing, frozen and killed, or drought stricken corn will be lower in moisture when harvested, perhaps 45 55% moisture. Palatability and dry matter intake can be affected as was described for haylge. Corn silage harvested in a green, very early maturity stage often has an excessive moisture level of 70% or more. The squeeze test as described for haylage (Greub and Cosgrove, 2006) is also a quick and easy method for estimating the moisture in corn silage.

Anti-quality Penalties

The anti-quality penalty section addresses length of chop, kernel depth, leaf damage due to disease or hail, and presence of smut. The length of chop is important here for the same reasons as in haylage, and the presence of excessive fine material less than 0.95 cm (3/8 inch) in length should be penalized. Corn silage sometimes contains excessively long [over 5.1 cm (2 inches)] and partially shredded stalk and leaf pieces because of dull or improperly adjusted knives in the chopper. Such material is not only less-than-ideal but may pack poorly allowing aerobic degradation, mold, or heat damage. The Weeds, Trash, and Other Foreign Material penalty section also is included for corn silage.

Figure 2:

CORN SILAGE SCORE SHEET
Univ. of Wisconsin – River Falls

[ ] DISQUALIFIED
[ ] Insufficient quantity
[ ] Does not meet class description
[ ] Corn grain added

Must Be Fermented

Sample Identification:________
Date:____________
Contest/Event: ______________________________
Judge(s):______________________________

Check one:

A. Grain Content and Maturity 40 points

	[ ] Chopped only Whole Kernel Content	[ ] Chopped & processed* Pulverized Grain Content		Score
1. Very high, black layer present in most kernels	40-38	1. High	40-38	
2. High; or up to 1/3 of kernels immature, pericarps empty	37-34	2. Medium	37-34	
3. Med. or 1/3 to 2/3 of kernels immature, pericarps empty. ...	33-25	3. Low	33-25	______
4. Low ; or over 2/3 of kernels immature, pericarps empty	24-10	4. Immature**	24-10	
5. None (ears removed or not developed)	0	5. No grain	0	

* Chopped material further treated to break up mature kernels for improved digestibility.
** Evidence of empty pericarps from kernels in liquid endosperm stage.

B. Color — 20 points

1. Desirable - olive green to slightly yellowish-green	20-19	
2. Acceptable - yellowish-green to slightly brownish or tan if frosted	18-16	______
3. Light tan or whitish indicating plants heavily frosted and/or weathered and bleached	15-12	
4. Undesirable - deep brown or black indicating heat damage or putrefaction	11-7	
5. Whitish, gray, or pink, indicating severe mold development	6-0	

C. Odor — 28 points

1. Very light, barely perceptible, pleasant odor	28-25	
2. A very definite, pleasant acetic acid or slight alcohol odor, not undesirable or indicative of spoilage or improper fermentation	24-21	______
3. Acceptable, but having a definite fruity, yeasty, or musty quality; slight burnt odor; or definite vinegar or alcohol odor	20-11	
4. Undesirable - definite burnt odor indicating excessive heating; strong sour, putrid , ammonia, or foul odor indicating improper fermentation or protein breakdown; very musty odor accompanied by excessive mold	10-0	

D. Moisture — 12 points

1. No free water can be squeezed out of sample; not overly dry to affect fermentation and palatability; well preserved	12	
2. Slightly too dry for best palatability, but no heat damage or mold	11-10	______
3. Excess water can be squeezed out of sample, but otherwise well-preserved	10-7	
4. Excessively dry with brownish color and slight burnt odor or slight mold	6-4	
5. Slimy or soggy with dark color and bad odor; or very dry with strong burnt odor or prevalent mold	3-0	

TOTAL POINTS (A+B+C+D) Max. = 100 ________

E. Antiquality Penalties

	Points off		
1. Chopped too fine, excessive amount of material < 0.64 cm (1/4") in length, adversely affecting digestive system and/or butterfat test ...	0-10	______	
2. Chopped too coarse, over 20% of material > 3.81 cm (1 ½") in length	0-8	______	
3. Corn kernels shallow, high proportion of cob	0-8	______	
4. Leaves diseased and/or hail damaged	0-8	______	
5. Clumps or pieces of moldy silage present	0-8	______	
6. Smut present	0-6	______	Total 1-6 ________

F. Weeds, Trash, and Other Foreign Material

Nonpoisonous or nonharmful: one point for each 1% of silage mass .... ________
Poisonous or harmful: three points for each 1% of silage mass .... ________

TOTAL PENALTIES (E+F) __________

PLACING ___________ **FINAL SCORE** __________

Additional Comments

We occasionally have had corn silage samples entered in contests where shelled corn was added in an attempt to improve grain content. Such samples are disqualified without being judged, thus the special box to so indicate at the top of the score sheet. Adulteration from dry corn grain sources generally is easy to spot and verify. The first indication may be the presence of two different-colored kernels in the sample because the grain added was of a different variety. However, this cannot be the sole basis for verifying an adulterated sample because farmers sometimes have mixed varieties in a field. More definite proof exists in that the added shelled corn kernels will not have undergone fermentation and are noticeably harder and drier than the fermented kernels. If one is so inclined, fermentation or the lack of it can be verified by chewing on the kernels in question. Fermented kernels will have a sour taste due to the presence of lactic acid while unfermented kernels lack the sour taste. However, if someone has gone to the effort of finding, picking out, and then mixing into the sample extra fermented kernels of a size and color similar to those originally present there is little that can be done to prove it. One may as well just give the entrant credit for recognizing the most important characteristic of high quality corn silage.

Final assignment of placings in both haylage and corn silage usually requires some sample to sample comparisons and re-examinations, especially within the top groups. In the end, the judge or judges should be able to justify the relative placings based on the score sheet scores given even if casual observation would not seem to support it. As with hay judging, accuracy in calculating final scores and maintaining correct sample identity are very necessary.

Summary

Evaluating silages for forage quality is an important process in their efficient use. Evaluating haylage requires attention to maturity, leafiness-steminess, color, and antiquality factors just as for hay. Corn silage requires consideration of the grain content and maturity as the most important components. Additionally, the effects of ensiling and storage on both types of crops must be considered by evaluating moisture and odor characteristics. Collectively, over all the hay and silage crop classes described in this paper and in Part I (Greub and Cosgrove, 2006), these score sheets are the result of over 30 years of experience in dozens of contests with thousands of samples and involving nearly 2000 students judging forage crop samples. The score sheet descriptions and the rationale behind them that we have presented here incorporate what we have learned through experience, suggestions from the students using them, and information available from a wide variety of sources in the published literature and University of Wisconsin research and extension work. The results obtained with their use in judging and placing samples in a contest probably will not agree 100% with results of laboratory analysis for ranking the samples anymore than the results of visually judging and placing dairy cows or meat animals are going to agree completely with milk production, rate of gain, or dressing percentage record rankings. However, we believe that these score sheets make silage evaluation without benefit of laboratory analysis results a relatively systematic, broadly accurate, and straight forward procedure that can be followed by individuals with a minimum of training and experience. Their use should provide acceptable results for many forage use applications.

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