

Hay Sampling And Grading

Hay Sampling Methods

Visually inspect the hay lot for uniformity. If not uniform, quality may vary too much for an accurate sampling. Even a good representative sample provides only an estimate of the average quality of a hay lot. And within a lot, quality between bales can vary greatly.

Obtaining a random but representative sample of hay for testing is extremely important. Laboratory results will be only as good as the sample submitted. Samples should be taken for each "lot" of hay. A lot of hay is defined as hay taken from the same harvest, same field, same species (pure or mixed) and variety, same type of harvest conditions, same method of baling, same method of storage, and same weather conditions during harvest. An individual lot should not exceed 200 tons.

If the lot is uniform, collect and composite 15 to 20 cores from the lot by using a bale probe. Select bales at random from the hay lot. The hay probe should have a minimum cutting diameter of ½ inch, a minimum internal diameter of inch, a minimum length of 12 inches, and a sharp tip to cut through the bale or hay package. Take cores from the center of the butt end of each selected bale. The probe should be inserted into the bale about 2/3 to 3/4 of its length. The cores should be bulked and thoroughly mixed together before the composite sample (a minimum of ½ of a pound and ideally about 3/4 of a pound) is placed in an airtight plastic bag for shipment to the lab. Send the sample to a certified lab (private, university, or government). If you store the sample for any length of time before shipment, place it in a cool place, taking care not to puncture the plastic bag. Airtight bags prevent changes in sample moisture content between sampling and analysis. When using a probe with an electrical drill, set the drill for slow speed. Avoid sending "grab" samples or flakes of hay.

Methods of Analysis

Two methods are used to analyze hay quality. The first is a complex series of chemical tests referred to as the "wet chemistry" methodology; the second is a newer, more rapid method of analysis referred to as Near Infrared Spectroscopy (NIRS). The NIRS method is used mostly for alfalfa hay since the procedure must be calibrated for each type of forage and for a range of growing conditions.

While most laboratories still use the traditional wet chemistry methodology, they have, or are incorporating, the newer, more rapid NIRS methodology. With the traditional wet chemistry,

testing requires several days, whereas the NIRS method samples are analyzed within minutes using near infrared light.

Visual analysis alone cannot accurately or consistently predict hay feeding value. Testing by either chemical or NIRS methods to predict hay quality, combined with a visual estimate will give the most reliable evaluation. Visual inspection to identify weeds and grasses in legume hays must supplement chemical or NIRS testing to predict quality accurately.

Hay Grading Systems

Currently, no uniform hay grading system exists nationwide for either legume, grass, or legume/grass (mixed) hays. One system for these hays has been proposed by the American Forage and Grassland Council (AFGC) and is presented in Table 1. It has not been widely adopted. Some consistency does exist in certain regions and within some states. Hay purchasers in each region should become familiar with the system in use in their state, region, or province.

Hay purchasers located in areas with no consistent hay grading system must evaluate each hay lot purchased. They can apply the hay grading system of their choice, sample hay and run chemical analyses to evaluate hay quality, or visually inspect hay and make an informed opinion of the hay. The best method involves combining visual judging with chemical analyses.

What The Buyer Must Know

The buyer should obtain as much information about the hay lot as possible. Learn about bale package size and weight, whether the bales are tied with string or wire, how long the hay has been stored, how the hay was stored, and under what conditions the hay was stored.

If stored outside, which is often the case in the western U.S., the buyer should learn before bidding on the hay whether it was covered during storage. If uncovered, ask whether the top and bottom tier of bales will be included in the lot. In humid regions, ask if the hay was stored in contact with the ground, and if the bottom tier of bales will be included in the lot. Also ask whether hay will be covered during shipment.

The current moisture content should be stated in advance because if not properly cured, mold may occur during or after shipment. If hay has a high moisture content (above 12 percent), the weight declines with time and the lot should be discounted to account for anticipated shrinkage.

Whenever possible, purchase hay by the ton and not by the bale. Variations in individual bale weight and size are not a concern when buying hay by the ton. However, when buying by the bale, you will need a scale to determine weight, size, and value of the hay by the ton so that an equitable price can be established.

In advance, develop an agreement with the seller as to who has responsibility for the hay during shipment. Also establish clearly who is paying for hauling costs and who is responsible for unloading and stacking the hay. Forewarn the seller if there are local roads and bridges

with load restrictions that may be exceeded by heavy truckloads of hay. Be certain that the delivery vehicle(s) can maneuver to where the load will be stacked even after a rain.

If the hay price includes hauling costs, it should be made clear whether the haul price is on a per ton of hay basis or a flat price per trip. Light bales result in light loads and this can drive up the price per ton. Agreement should be obtained for delivery mode (rail, backhaul trucks, and maximum truck size allowed on the buyers facility), delivery date, and approximate arrival time.

Come to an agreement concerning the buyers right to reject hay upon delivery. The obligations of each party in the event a hay shipment is rejected should be understood in advance.

Agree on the method of payment, time of payment or payment installments in advance. Be certain that any agreements reached are in compliance with state and local laws.

Interpreting Forage Analysis

Crude protein (CP) is a calculated value derived from the forage nitrogen (N) content usually determined by a chemical procedure known as Kjeldahl-N analysis. Crude protein is calculated using the formula: $CP = \%N \times 6.25$. The value includes true protein and non-protein N. Animals can use both types to some degree. CP values give no indication of heat damage that can alter protein availability.

Table 1. Proposed Quality Standards for Legume, Grass, and Legume-Grass Mixed Hays.

	Analysis (b)					
Quality Standard (a)	CP	ADF % of DM	NDF	DDM (c); %	DMI (d) % of BW	RFVe
Prime	>19	<31	<40	>65	>3.0	>151
1	17-19	31-35	40-46	62-65	3.0-2.6	151-125
2	14-16	36-40	47-53	58-61	2.5-2.3	124-103
3	11-13	41-42	54-60	56-57	2.2-2.0	102-87
4	8-10	43-45	61-65	53-55	1.9-1.8	86-75
5	<8	>45	>65	<53	<1.8	<75

(a) Standard assigned by Hay Market Task Force of AFGC.

(b) Analysis associated with each standard: CP = Crude Protein; ADF = Acid Detergent Fiber; NDF - Neutral Detergent Fiber.

(c) Digestible Dry Matter (DDM%) = $88.9 - 0.779 \text{ ADF (\% of DM)}$.

(d) Dry Matter Intake (DDE, % of body Weight) = $120 - \text{forage NDF (\% of DM)}$.

(e) Relative Feed Value (RFV) calculated from $(\text{DDM} \times \text{DMI})/1.29$

Unavailable protein (UP) is reported if heat damage is suspected and an analysis of UP is requested. It gives an indication if excessive heating has occurred that might reduce protein

digestibility. All forage has some UP (up to 12 percent. Also reported as ADF-N protein, ADF-CP, bound protein, or insoluble protein.

Acid detergent fiber (ADF) refers to the cell wall portions of forage made up of cellulose and lignin. ADF reflects the ability of an animal to digest forage. As ADF increases, digestibility of a forage usually decreases.

Neutral detergent fiber (NDF) is the total cell wall component or the ADF fraction plus hemicellulose. NDF values are important in ration formulation because they reflect the amount of forage the animal can consume. As NDF increases, dry matter intake (DDI) generally decreases.

Crude fiber (CF) is a component of an older forage analysis system which did not account for some of the hemicellulose and lignin components. It differs from ADF by not including the mineral fraction especially silica.

Lignin is a non-carbohydrate substance that is a prime factor influencing the digestibility of the plant cell wall material. As lignin increases, digestibility, intake, and animal performance usually decrease and the percent ADF and NDF increase.

Following are calculated values generated from equations that use data from the analysis of a forage sample. Laboratories do not have to use the same or a standardized formula. Comparisons between labs is difficult.

Digestible protein (DP) is generated using some percent (70 or 72) of CP or other formula. It has little practical value in formulating rations.

Digestible dry matter (DDM) is an estimate of the digestibility of the forage. It is usually calculated from the percent ADF and is in part based on feeding trials with animals.

Total digestible nutrients (TDN) also estimates forage digestibility. Some labs use the same formula to calculate TDN as they do for DDM.

Dry matter intake (DMI) is an estimate of the relative amount of forage an animal will eat. It is based on animal feeding trials and NDF percentage. Digestible dry matter intake (DDMI) is an estimate of how much DDM an animal will consume and also estimates digestible energy intake (DEI). DDMI is calculated by the equation $[(DDM \times DMI)/100]$.

Relative feed value (RFV) is an index that combines the important nutritional factors of intake and digestibility. It has no units, but allows comparisons of legume, grass, and legume-grass forages. RFV increases as forage quality increases. As percent ADF and NDF decrease, RFV increases. It is calculated using the formula $[(DDM \times DMI)/1.29]$.

Table 2. Hay Probe Resource List(a).

Probe name	Company address/telephone number	Probe description
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E-Z Probe	Techinserve Inc. 1213 SW Highway 97 PO Box 848 Madras, OR 97741 (503) 475-2209	A stainless steel probe with resharpenable steel tip. Unit has a canister attached where cores are collected as bales are sampled. Holds up to 30 cores. Probe cuts a core 0.5 inch in diameter and 12 inches long. It is designed for use with hand brace (not supplied).
Forageurs Hay Probe	Forageurs Corp. 20788 Holyoke Ave., W. Lakeville, MN 55044 (612) 469-2596	Stainless steel probe with resharpenable hardened-steel tip. Unit has a canister attached where cores are collected as bales are sampled. Holds 25 cores. Probe cuts a core 0.6 inch in diameter and 14 inches long with longer 24-inch probe also available. Designed for use with hand brace (not supplied) but can be used with an electric drill.
Penn State Forage Probe	Nasco 901 Janesville Avenue PO Box 901 Fort Atkinson, WI 53538 (414) 563-2446	Stainless steel probe with replaceable cutting tip. Probe must be disassembled and emptied after each core is taken. Probe cuts a core 0.75 inch in diameter and 17 inches long. Probes available for use with electric drill or hand brace (not supplied).
Oakfield Probe	Oakfield Apparatus Inc. PO Box 65 Oakfield, WI 53065 (414) 583-4114	Stainless steel probe with a replaceable serrated screw-on tip. Hay sample is removed from the side of the tube after each core is taken. Extension rods are available for larger bales. Designed for use with a hand brace (supplied), but adapter for use with electric drill is available.
Hay Chec Sampler	Hodge Products Inc. PO Box 1326 El Cajon, CA 92022 (619) 444-3147	A 12-inch probe with built-in handles and sample collection jar in one unit. Probe cuts a core 7/16 inch in diameter and is pushed, not rotated, into the bale for sample collection.

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