

Hay Testing and Quality

Ellen Phillips, Extension Educator
University of Illinois Extension, Countryside Extension Center
708-352-0109
ephillips@illinois.edu

What is Forage Quality?

The capacity of a forage to supply animal nutrient requirements.

This includes:

- acceptability (palatability),
- chemical composition, and
- nutrient digestibility.



Will the animal consume it and be able to digest it?

Once digested, will the forage provide the needed nutrients for growth and good health?

What Factors Affect Forage Quality?

1. Species

- Legumes vs. grasses / mixtures
 - Legumes are higher in protein and have faster rates of fiber digestion.
- Cool-season vs. warm season
 - Cool season grasses are more digestible due to anatomy differences.



2. Cultivars

- Breeding can improve quality and maturity differences can be large.

3. Temperature

- Plants grown at high temperatures produce lower quality forage due to lignification.

4. Maturity stage

- Maturity stage at harvest is the most important factor determining forage quality of any species

What Factors Affect Forage Quality?

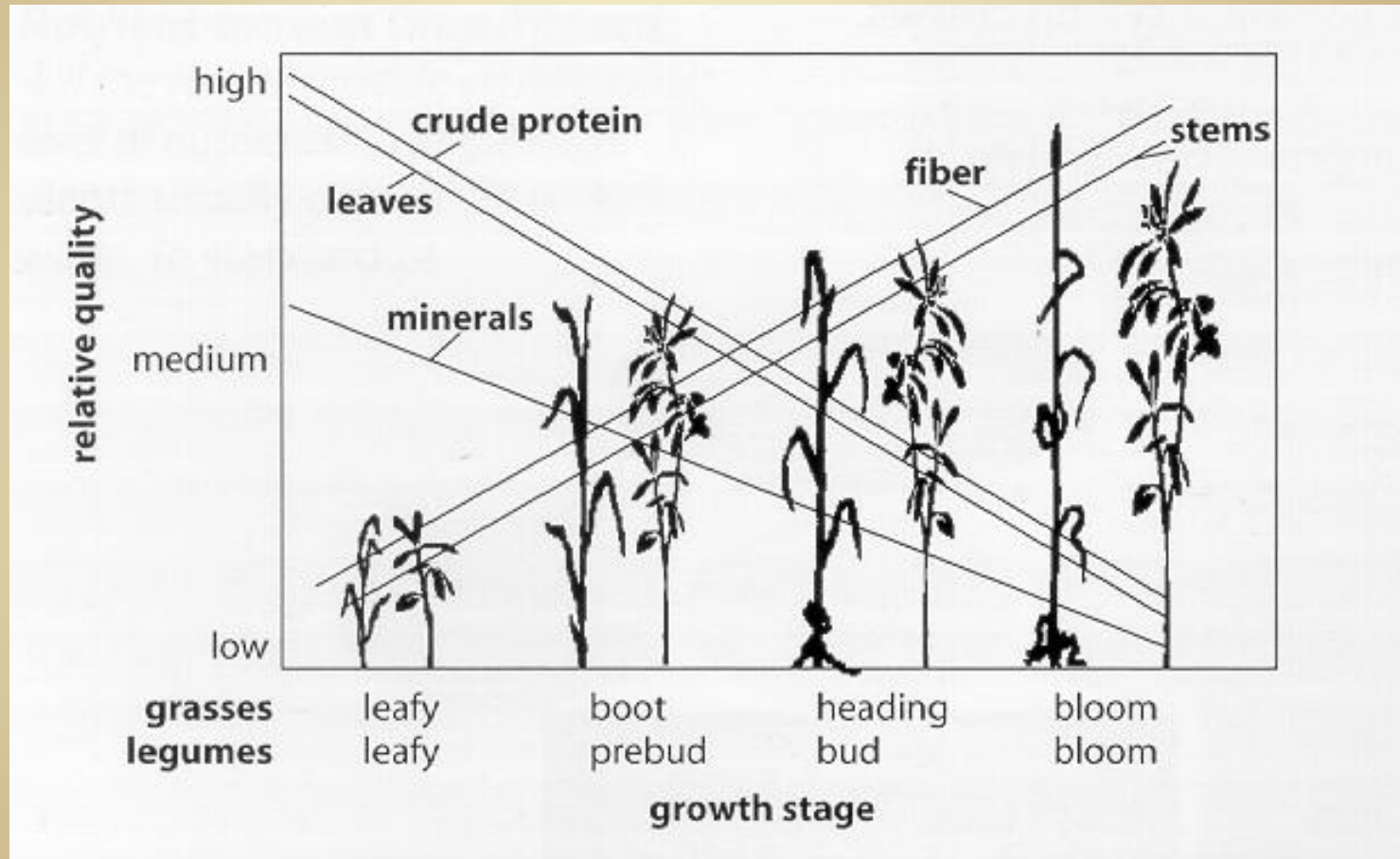
Maturity stage

Forage quality declines rapidly with advancing maturity.



Maturity stage:

Forage quality declines rapidly with advancing maturity.



What Factors Affect Forage Quality?

5. Leaf-to-stem ratio

- Leaves are higher in quality than stems.

6. Fertilization

- Most important for grasses; N fertilization increases yield and crude protein ($\%N \times 6.25$).

7. Harvesting and storage techniques

- Field losses include rain damage, leaf loss, and plant respiration.
- Storage losses to uncovered bales can be 40%.

Forage Quality Evaluation

How are forages tested?

- Sensory evaluation
- Chemical analysis
- Feeding trials.



Forage Testing:

Sensory



What are the factors?

- Species
- Maturity stage
- Leafiness
- Color
- Odor & condition
- Foreign material



Common Hay Species for Horses



- **Legume**
 - Alfalfa
 - Clover*
- **Grass**
 - Timothy
 - Orchard
 - Brome
- **Mixed**
 - Alfalfa X Grass

Evaluate it.

- Ask that one or several bales are opened so you can see the hay inside the bales.
- Do not worry about slight discoloration on the outside, especially in stacked hay.



Feel it.

- Choose hay
 - fine-stemmed
 - leafy
 - soft to the touch.



Smell it.

- Avoid hay that smells
 - Moldy
 - Musty
 - Dusty
 - fermented.



Age it.

- Check the leaves, stems and flowers or seed pods to determine the level of maturity.
- Harvested when the plants are
 - in early bloom for legume hay
 - before seed heads have formed in grasses.



Judge it.

- Avoid hay that contains significant amounts of
 - Weeds
 - Dirt
 - Trash
 - debris.



Eyeball it.

- Examine hay for signs of
 - insect infestation.
 - check for blister beetles in alfalfa., usually drought years
 - Ask the grower about any problems in the region.
 - Disease
 - Black patch on red clover



Weigh it.

- Reject bales that
 - seem excessively heavy for their size
 - feel warm to the touch
 - could contain excess moisture
 - could cause mold, or worse, spontaneous combustion.



Forage Testing:

Feeding Trials

The “truest” method:

- Based on animal performance measures
- Used to calibrate other methods
- Expensive, lengthy



Forage Testing

- Base horse's diets on forage – not grain!
- **Only useful if buying large loads**
- Good information for high performance or growing horses



Table 9. Reliability of Hay Quality Evaluation Techniques

Quality factor	Reliability by	
	Visual inspection	Chemical analyses
Green color	Excellent	Poor
Maturity	Good - poor (2nd cut)	Good
Variety	Good	Poor
Impurities	Excellent	Poor
Mold	Excellent	Poor
Nutrient content	Poor	Excellent
Moisture content	Fair	Excellent
Heat damage	Good - poor	Excellent

Forage Testing: Chemical Analysis

Two techniques:

- Traditional laboratory
- NIRS (near infrared reflectance spectroscopy)



Forage Testing:

Chemical Analysis – Traditional

Also called “wet chemistry”

- Uses acids, detergents, solvents, extractions, drying ovens, and balances
- Standard procedures defined by professional association (AOAC; now the Association of Analytical Communities: <http://www.aoac.org/>)



*The Scientific Association Dedicated
to Analytical Excellence[®]*

Forage Testing:

Chemical Analysis – NIRS

(Near Infrared Reflectance Spectroscopy)

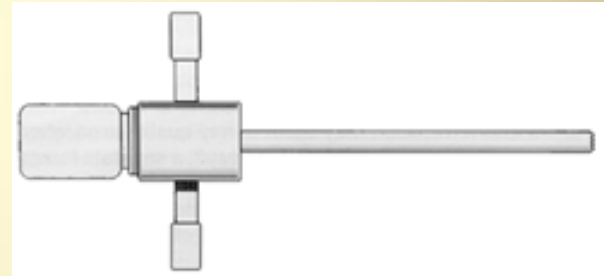
- **Techniques developed by years of applied research by USDA ARS scientists.**
- **Improved and has become popular in last decade.**
- **Fast and precise, but must be adequately calibrated to be accurate.**
- **NIRS works like this: A special lamp emits energy into a grating that separates it into a rainbow of wavelengths between 1100 and 2500 nanometers. The energy is focused onto a sample of material, and detectors read the patterns of reflectance.**

Forage Sampling:

the basis of all analyses

Sample must be:

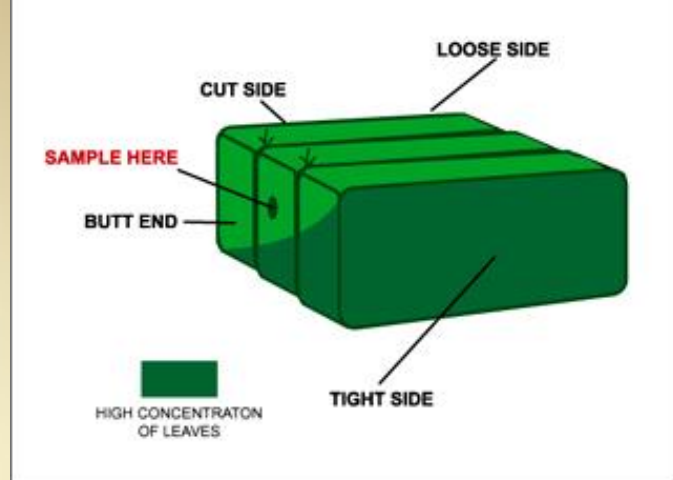
- Representative of what's being predicted



Forage Sampling:

How to sample hay?

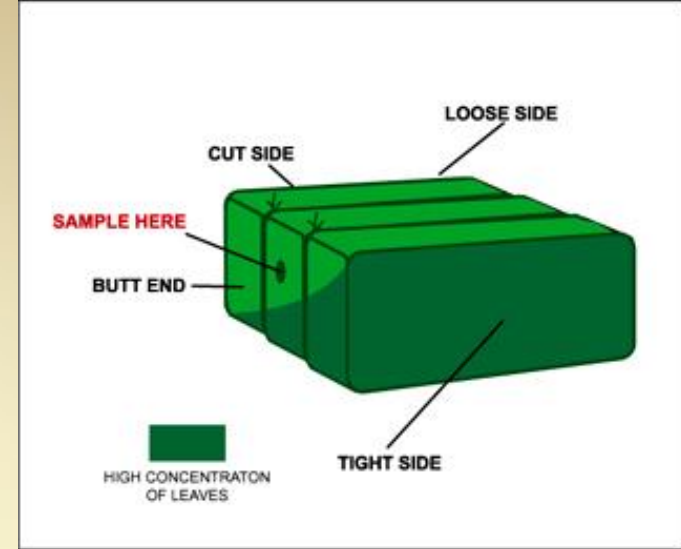
- **Timely sampling.**
 - It is important to sample the hay either as close to feeding, or as close to point of sale as possible.
- **Square bales**
 - Sample butt ends of the hay bale
 - between the strings or wires, and not near the edge.
- **With round bales**
 - Sample the rounded portion towards the middle of the bale on an angle directly towards the center of the bale
- **Use a core sampler**
 - Internal diameter $\frac{3}{8}$ – $\frac{5}{8}$ "
 - samples should not be split



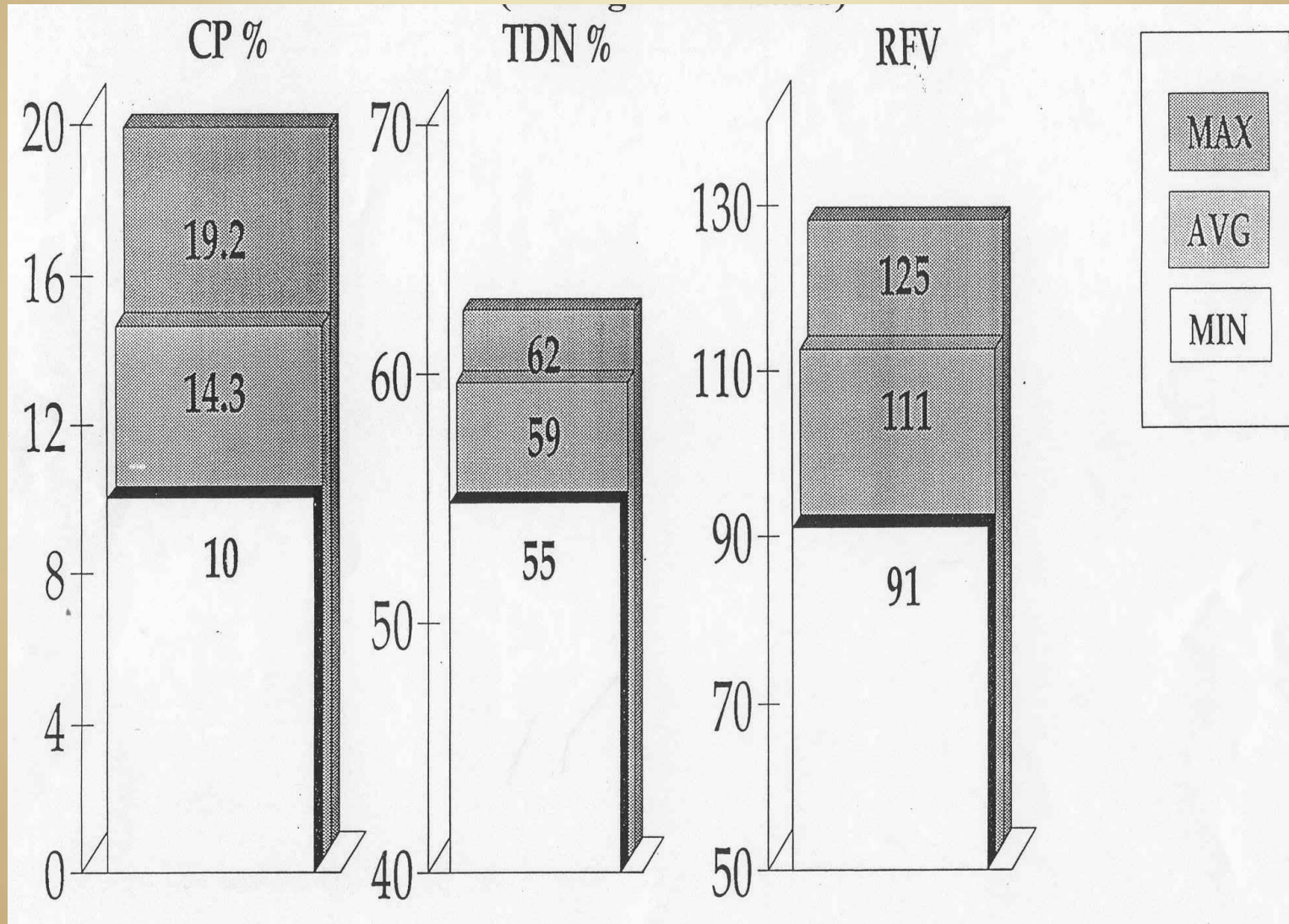
Forage Sampling:

How to sample hay?

- Take “enough” samples
 - At least 20 per “lot”
- Use a sampling plan
 - Obtain random sample
- Send to lab immediately
- Don't subsample
 - Unground samples should not be split



Variation seen in different bales of mixed legume/grass hay (avg 20 bales)



National Forage Testing Assoc.

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News & Announcements

- [Laboratory Feedback Session, September 4, 2008, 1:00 p.m. CT, Teleconference Summary and Transcript](#)
- [Presentations from NIRSC/NFTA/FeedAC Joint Annual Meeting on Feb 13-14, 2008, Indianapolis, IN](#)
 - [1. Opportunities Inputting Lab Values in Ration Software](#)
 - [2. Feed and Forage Analyses - Issues in characterizing inputs needed for CNCPS/CPM Dairy and NRC models](#)
 - [3. NDF Digestibility: From the Lab to the Cow.](#)
 - [4. A Comparison of Methods for Feed Fat Analysis](#)
 - [5. The Application of NIRS for Commercial Forage Analysis](#)
 - [6. Improving the Efficiency of Use of Nitrogen in Lactating Dairy Cattle: Revisiting the CNCPS Approach](#)
 - [7. Biomass Characterization Using NIR Spectroscopy](#)
 - [9. Introduction to the AAFCO Collaborative Check Sample Program](#)
 - [10. Joint discussions between NIRSC, FeedAC & NFTA: what are our strengths and potential joint efforts; what are our commonalities?](#)

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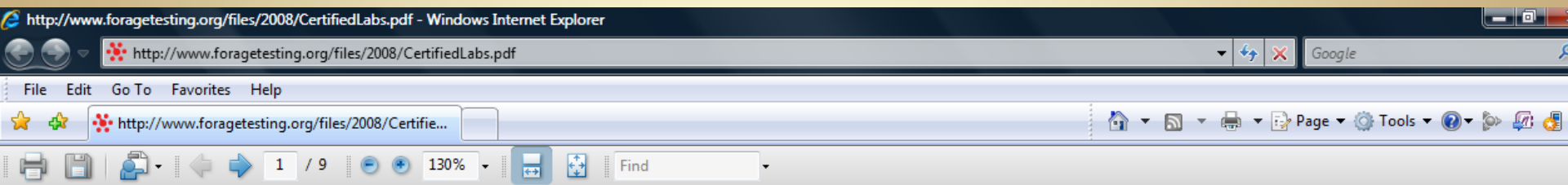
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NATIONAL FORAGE TESTING ASSOCIATION

Post Office Box 451115

Omaha, Nebraska 68145-6115

Tele: 402 333-7485

Email: NFTA@COX.NET

Fax: 402 691-0636

Web Site: www.foragetesting.org

CERTIFIED LABORATORY FACILITIES

A&L Canada Laboratories, Inc.
Dave Stallard
519 457-2575

2136 Jetstream Road
London ONT CANADA N5V 3P5

Chemistry

A&L Great Lakes Laboratories, Inc.
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Buying horse hay

Dan Undersander, Jim Morrison, Ellen Phillips, Richard Loop,
Paul Peterson, and Craig Sheaffer

Whether used for work, sports, recreation or companionship, horses need high-quality forage. Not all hay has the same quality, even that grown or harvested at the same time. Quality hay has a high nutrient content and is free of dust, mold, and other foreign matter. Horses can be nutritionally deficient even when plenty of forage is available to them. Alternately, leisure horses can be overfed and encounter health problems due to diets too rich from very high-quality hay. Knowing the hay's forage quality is the key. This publication describes the nutrient needs of horses, helps you determine how much and what quality hay you'll need, and provides a detailed checklist to guide you when contacting hay sellers.

Horses are natural forage eaters. Though not ruminants, they do best with forage-based diets. A horse's front teeth are ideally adapted for biting off grass. Its back molar teeth are better adapted for chewing feed

such as pasture or hay than for grinding corn. Horses have a smaller digestive tract than most ruminants and cannot handle as much bulk at one time. Even so, lack of sufficient forage in a horses diet can lead to digestive orders.

The myths of feeding horses

There are more myths associated with feeding horses than with most other animals. The myths are often spread by horse owners who have little basic animal nutrition training. For some, "horse hay" means dry, dust-free, mature grass hay. This type of hay tends to be low in energy and protein, and may not meet the horse's needs. Grass hay or grass mixed with mature legumes is often best for mature idle horses that are housed primarily indoors. However, young growing horses, pregnant or nursing broodmares, and athletic performance horses need more energy, protein, vitamins and minerals than this type of hay can provide. Some horse

owners erroneously believe that feeding high-quality hay that contains legumes invariably leads to digestive upset. In fact, high-quality hay (e.g., young alfalfa) can reduce the need for additional supplement and will not cause digestive problems unless the quality or amount fed exceeds the animal's needs.

A more responsible approach is to recognize that all horses need some hay and pasture. Feeding costs generally decline and animal health improves as hay is maximized and grain is minimized in the horse diet. This can be accomplished by feeding the highest quality forage appropriate for your horse. The best quality forage for your horse will depend on many factors including age (growing vs. mature), physiological stage (e.g., pregnant vs. not), and activity level. Refer to figure 1 for specific forage quality needs for different activity levels.

The horse's digestive system

The horse's digestive system is vastly different from other large domestic animals (ruminants). While horses are natural forage eaters, they do not have the large rumen for forage to flow into and be digested by microbes. Instead, consumed feed goes immediately to the stomach, which has relatively limited capacity. This is why horses are more susceptible to molds that would be digested in the rumens of cows or sheep. Feed passes more rapidly through a horse's digestive system than it does through a ruminant's, preventing them from

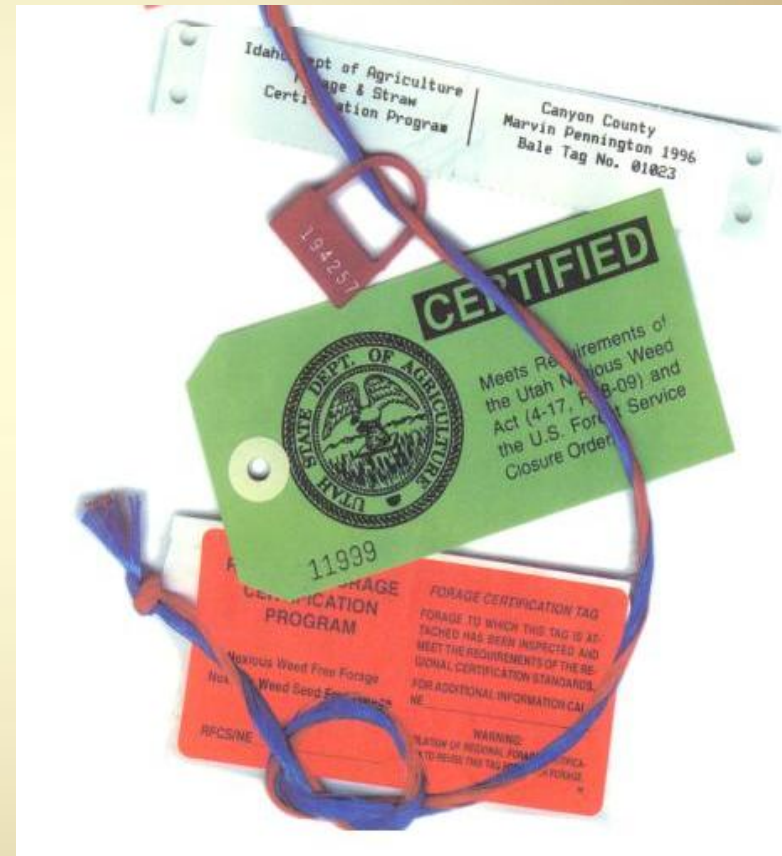


Illinois Certified Hay Program

<http://www.nawma.org/>

**PLEASE
DON'T FEED
WEEDS
& SEEDS**

**YOU MUST USE
REGIONAL
CERTIFIED FORAGE
IN THIS AREA.**



Key Concepts to Remember

- Ultimate measure of forage quality is animal performance.
- Most important factors are: forage species, stage of maturity at harvest, harvesting and storage techniques.
- Forage quality varies greatly and nutritional needs vary among and within animal classes.
- Leaves are higher in quality than stems.
- Legumes are usually higher in quality than grasses.
- Cool season forages are usually higher in quality than warm season forages.
- Delayed harvest due to concern about rain probably results in more forage quality loss than does rain damage.

Key Concepts to Remember (continued)

- Sensory evaluation provides important information but lab testing is required to formulate rations.
- Lab analysis uses only a few grams of material, so sampling technique is extremely important.
- Lab values are valuable but not absolute.
- Digestible energy is usually the limiting factor from forage for livestock performance.
- Lower quality forages, more mature and fibrous, take longer to digest and result in lower intake.
- Major losses in forage quality occur due to poor storage and feeding techniques.