Understanding Forage Analysis Important To Livestock Producers

Forage testing provides a measure of the nutrient content of hay or pasture that animals are consuming. Comparing the forage's nutrient content with the animal's nutrient requirements enables a producer to see if supplements are needed to improve animal performance or health. A forage analysis report contains information on such attributes as moisture, fiber, digestibility, protein, and mineral content.

**Moisture**
Moisture content is an indication of how well the forage was dried before storage. Hay should be baled when the moisture content is less than 20 percent; high-density, large, round bales need a moisture content below 16 percent. Haylage should be made when the moisture content is 35 percent to 50 percent. Most hays will dry to 10 percent to 15 percent moisture during storage, but some round bales are higher in moisture if stored outside.

**Fiber and energy**
Forages vary widely in fiber content. Fiber content is the best estimate of how digestible the forage is and how much of it the animal will eat. Well-managed pasture or hay can be low in fiber and highly digestible. Late-cut hay is usually high in fiber but low in digestibility and intake. Two types of fiber are measured-acid detergent fiber and neutral detergent fiber.

Acid detergent fiber (ADF) is the less-digestible cellulose and lignin or "woody" fiber in the plant. ADF is an indicator of digestibility across different species of grasses and legumes. As ADF increases, digestibility decreases.

Neutral detergent fiber (NDF) is an estimate of the plant's cell wall content and includes the ADF and hemicellulose. Some of the NDF is highly digestible. Forage NDF is the best indicator of how much forage a high-producing animal will eat. A high-producing dairy cow can eat about 1.1 percent of her body weight in NDF. For example, a 1,300-pound cow is able to eat about 29 pounds of grass hay containing 50 percent NDF (1300 x 0.011/0.50=28.6). She could eat 36 pounds of a grass-legume hay containing 40 percent NDF. Livestock eat more legume than grass hay because legumes are lower in NDF than grasses.

Energy available from the forage may be expressed in different units of measure. Different labs may use different equations. In general, across grasses and legumes, ADF is a good indicator of digestible dry matter or total digestible nutrients (TDN). NDF is the best indicator of net energy lactation (NEL), net energy maintenance (NEM) or net energy gain (NEG) since intake has a major effect on a forage's net energy content. As the NDF content of the forage increases, forage intake and net energy content decrease.

**Nonfiber carbohydrates**
Nonfiber carbohydrates include pectin, starch, and sugar, which are nearly 100 percent digestible in the rumen. The rumen bacteria need these carbohydrates for energy to grow.

**Crude protein**
Crude protein (CP) is the nitrogen and amino acids in feeds. The animal's rumen bacteria use the crude protein as they digest forage. After they digest the forage for their growth, the bacteria are digested in the animal's true stomach. The animal uses the amino acids for growth and milk production. Many laboratories measure available and unavailable protein. When a feed is heated, some of the protein becomes unavailable because it is tied up with other compounds. This happens when damp hay is baled, causing it to heat, or when silage is stored without all the air being removed, which allows excessive heating.
In ration formulation, CP is divided into classes based on how fast it is degraded in the rumen. These classes are termed soluble, degraded, and undegraded intake protein. Newer ration balancing literature calls them rumen degradable protein and rumen undegradable protein.

Soluble intake protein is rapidly degraded to ammonia in the rumen. Some of this rapidly available protein is needed by the rumen bacteria when their growth rate is high. However, excess soluble protein will degrade to ammonia and be lost.

Degraded intake protein is all the protein that is degraded in the rumen. Rumen bacteria use degradable protein for growth as they digest the fiber and nonfiber carbohydrates. If the ration contains too much degradable protein compared with the rumen digestible carbohydrates, it is converted to ammonia, lost from the rumen, converted to urea, and excreted in urine. The protein is wasted. This process increases the animal's energy requirement. In extreme cases, this can result in lower milk production or lower rate of gain in growing animals. Degradable protein is less likely to be wasted if adequate digestible carbohydrate sources are available to the rumen bacteria.

Undegraded intake protein is not degraded in the rumen, but it may be digested in the intestinal tract.

The goal of balancing a ration is to ensure that there is enough CP and that the proportion of degradable and undegradable protein meets the needs of the cow and its rumen bacteria. Perennial forage crops vary in protein content. Perennials having higher legume content are usually higher in crude protein at the same stage of maturity. Dry hay tends to have less protein than silage and well-managed pasture. Because of fermentation, much of the protein in silages is readily degradable.

The CP content of well-managed pasture usually exceeds the needs of high-producing livestock. However, the amount of degradable protein in pasture is greater than the needs of the rumen bacteria.

Minerals

Forage tests usually include the major minerals (calcium, phosphorus, magnesium, potassium, sodium, and sulfur) and the trace minerals (iron, zinc, copper, manganese, and molybdenum). Often, the tests do not include other minerals (cobalt, selenium, and iodine) needed by livestock.

The mineral content of forages varies, depending primarily on plant maturity and species present in the forage. Sometimes, low soil fertility limits plant growth. Fertilizing and liming may change the botanical composition of the stand, thereby changing the mineral levels in the forage. For example, phosphorus fertilization and liming may increase the legume growth in a pasture, which increases the calcium content of the forage.