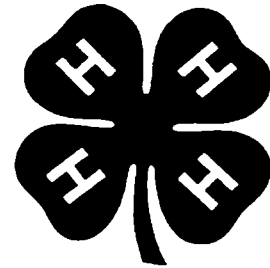


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# Oregon 4-H



# Forage Teaching Series

This series of leader guides is designed to help provide experiences related to forage quality for youth and their families. The individual sheets may be duplicated for distribution to members.



# Introduction To Grasses And Legumes

## Leader Guide

This plant science activity provides information about plants that can benefit and harm livestock and horses. The series which includes two slide-tape sets and ten publications is a supplement to 4-H livestock and horse programs.

Supplementary material for leaders includes suggestions for recognizing plants in the field, activities to use as learning experiences, and tips for agents and leaders in setting up plant identification contests. Using this material and participating in these activities will add interest to club meetings and broaden the educational experience for your club members.

Using these materials strengthens the club members interest in nature. It can lead to a better understanding by 4-H members of the role of grasses and legumes in the pasture and in animal nutrition. This activity can also help members recognize hazardous or poisonous plants that could injure animals.

Members can learn to appreciate the role of plants in nature and their role in the food chain. These plants form the basic food for animals through harvest as pasture, hay, or grains.

Grasses and legumes are some of the most important plants to humans. They include forage plants which are essential to livestock, and plants that produce grains, which provide food for humans.

Plants in the grass classification grow in a way that helps them survive livestock grazing. The sensitive growing point stays close to the ground where it is protected from animals.

Legumes have a unique ability to combine with bacteria to convert the nitrogen in the atmosphere into a form usable by the plants. When people make this conversion (through nitrogen fertilizer), they consume a large amount of energy. Thus, the legume plant assumes a more important role as we attempt to conserve non-renewable energy sources.

The forage plants of primary interest in livestock production are classified as grasses or legumes. Lesson plan materials for this plant science activity include:

### Materials Provided

#### Slide Sets:

- Introduction to Grasses
- Introduction to Legumes

The slide sets provide a general description of seven grasses and seven legumes found in fields and pastures in Oregon. The slides (with tape narration) can be used for a general introduction to plants. A review may be repeated in later sessions to illustrate and re-emphasize the plant characteristics used in identification. These are available from the State 4-H Audio-Visual Library through your county Extension Office.

01L

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## Other publications in the Oregon 4-H Forage Teaching Series, 4-H 1001L

- |   |  |
|---|--|
| 02L Using Plant Science Activities as a Learning Experience | Suggests activities to reinforce learning experiences in plant identification for leaders and Extension faculty.   |
| 03L Recognizing Plants in the Field                         | Suggestions for organizing and directing a field trip to study plants.   |
| 04L Forage Quality: What It Is and Why It Is Important      | Provides information to teach youth on the factors affecting quality. Explain the importance of forage quality in livestock feeding programs.  |
| 05L Tips For Teaching Forage Quality                        | Suggests teaching techniques for leaders to teach skills in visual evaluation of forage.   |
| 06L How to Set Up a Plant Identification Contest            | Provides leaders and Extension staff tips on how to set up and effectively use contests as an education experience.  |
| 07L Plant Identification Illustrated Glossary               | Acquaints members with the simple terms used to describe plants. The terms include those in the slide set and in the plant identification key introduced later.  |
| 08L Collecting, Preserving, and Mounting Plant Materials    | Teaches preparing plant mounts as a club activity. These mounts can be used for teaching and reviewing plant identification. Mounts can be exchanged with other clubs in the county and other parts of the state to build a complete collection. |
| 09L Forage Quality: What to Look For in Evaluating Hay      | Provides 4-H members the factors to consider in evaluation.  |
| 10L How to Use a Plant Identification Key                   | Acquaints club members with the use of keys in plant identification. Simple keys to identify cereals and forage legumes are provided.  |

This lesson plan is designed to provide leaders in livestock and horse clubs with sufficient resource material on plant identification and evaluation. Leaders may then introduce plant identification and evaluation to members. Through the activities suggested and innovative use of presentations by club members, this lesson plan can broaden activities available to 4-H members and help youth use the information for better management of livestock feeding.

*Prepared by Harold Youngberg, Extension specialist emeritus, Oregon State University.*



# Using Plant Science Activities as a Learning Experience

## Leader Guide

Plants provide feed for livestock and food and fiber for humans. Their use in conservation and beautification plantings also improves our environment.

Plant science activities provide many valuable learning experiences in livestock and horse club programs. Club members should recognize the most beneficial and nutritious pasture plants and be acquainted with the characteristics of the major pasture plants. This knowledge will help them understand pasture management and factors that affect productivity. The ability to recognize and remove undesirable weeds and poisonous plants in pastures may save a club member's animal from sickness or death.

Many plant science activities can be used as learning experiences in the club program. These include:

**Tours and field trips.** Discuss plants and their role in livestock production during tours and field trips. If you are conducting a livestock tour, observe and discuss the pastures and crops on the farms visited. Arrange special field trips or tours to identify forage grasses and legumes or identify and collect plants dangerous and poisonous to livestock; or recognize cereal crops in the field.

**Collection and preservation of plant material.** Collect and preserve plants as part of a tour or a special outing.

**Collection of seeds.** Collect grains, pasture grasses, and legumes as part of a field tour or from seed stocks available through warehouses and seed processors.

**Identification contests.** Use 10 to 20 plants in plant mounts, fresh plant specimens, or seed collections for contests at club meetings.

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**Presentations by members.** Plant studies offer many opportunities for member presentations to their club, to other clubs, or at county fairs. The following are a few suggestions:

- Productive pasture grasses (or legumes) in your area.
- Establishing and managing pastures.
- Recognizing poisonous plants.
- Controlling pasture weeds.
- Grazing management for best pasture production.
- Factors to consider in evaluating grasses (or legumes).
- Economic feeding starts with forage quality.

References in libraries or interviews with county Extension agents or soil conservation staff can provide material for preparation of presentations.

These activities can be conducted at a season of the year to complement the club program. The following calendar of activities may be helpful in planning:

#### **Spring**

- Tour of pastures, field crops, and native areas.
- Collect and preserve plant material.
- Discuss characteristics useful in identifying plants that members bring to the club meeting.

#### **Summer**

- Collect and preserve plant materials.
- Tour turf and irrigated pastures to identify plants and discuss management.
- Field trips.

#### **Fall**

- Study identification of plants from mounts.
- Discuss special characteristics helpful in identifying plants.
- Collect references on plant description.
- Field trips to seed processing operations.

#### **Winter**

- Collect seeds of grains and pasture plants.
- List species found in different environments.
- Use plant mounts and seeds in a club contest.
- Challenge other clubs to identification contests.

Do not consider plant and seed identification as an end to itself but rather an integral part of the club program. Stress the role of the plant in animal nutrition. Discuss control measures, the dangers of undesirable and poisonous plants, and the importance of recognizing feed grains and their role in balancing livestock rations.

# Recognizing Plants In The Field

## Leader Guide

Field trips and hikes are an ideal way for young people to learn about plants. Leaders can plan and conduct numerous successful learning experiences.

The experience can take the form of a brief walk around the neighborhood or farm to observe plants in the lawn, farmyard, and fields; a spring or summer field trip planned specifically to learn more about plants; or a few minutes of livestock tour to identify and discuss plants growing in pastures, along roadways and ditches. The leader should direct the group's attention to beneficial plants as well as those that are injurious or poisonous to animals.

The amount of advance planning will depend upon the situation. In any case, the leader must prepare to identify the plants encountered. An inspection of the area before the tour will help the leader note plants to bring to the attention of the tour group and to prepare for questions.

The leader must consider the level of understanding of the club members. Before the field trip, members should be familiar with plants in general, their features, and some of the terms used to describe them. The slide sets, "Introduction to Grasses" and "Introduction to Legumes," could be used in a training meeting held prior to an actual field experience.

Leaders should not introduce too much material on a field trip. Judgment on content can be based on the response of the members. It's important to maintain the interest of the members without overwhelming them.

Resource people in the county or neighborhood should not be overlooked. Every community has individuals who have knowledge of plants and who might be willing to work with members. Extension agents and others with training in plant identification can be of assistance with new or difficult-to-identify plants.

Leaders should be acquainted with the use of keys and other reference material available to aid in plant identification. Groups can begin by studying the more common plants and advancing as appropriate.

A club activity might be developing a list of plants commonly found in the area, grouped according to the locations in which they grow (roadsides, pastures, grain field, lowlands, and native range land). This list helps the club member to recognize that some plants are restricted to certain environments while others are adapted to many environments. It can also be used on field trips.

The "Pocket Guide for 4-H Hikes" (4-H 3001) has a checklist of plants to use on a tour or hike. This guide is available through the county Extension office.

An important part of field activities is collecting plant materials for review or teaching. A plant press and tools to take plant specimens should be available. Instructions for collecting and preserving plants and making plants mounts are included in another sheet of the series, "Collecting, Preserving and Mounting Plant Materials."

*Prepared by Harold Youngberg, Extension specialist emeritus, Oregon State University.*

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## Forage Quality

# What It Is and Why It Is Important

## Leader Guide

Forage crops are those grown primarily for livestock feed and harvested to be fed later, or harvested directly by grazing animals. Included are all plants grazed by animals or harvested for hay or silage.

Since forages are consumed by animals, the product fed must be acceptable to the animal. Forages are marketed primarily in the form of animal products, that is, meat, milk, or wool, so the animal must be considered in the development of a sound forage feeding program. A high quality forage has a high feeding value per unit and also is more readily consumed.

### What Is forage quality?

The term *quality*, as applied to forages, generally means the same as feeding value and may be defined as the ability of a forage to supply animal nutrient requirements for a specific production function (meat, milk, or wool). The equation for quality may be written:

$$\text{Quality} = \frac{\text{Available nutrients}}{\text{per unit of forage}} \times \text{Rate of intake}$$

The value of forage for the production of meat, milk, or wool, therefore, depends on the availability of the nutrients consumed and the quantity of forages voluntarily consumed. When the daily intake of forage, the

chemical composition, and the digestibility are known, the daily intake of nutrients can be calculated.

### Meeting animal requirements

A simple approach to the determination of the energy needs of an animal—or the need for any nutrient—is:

$$\begin{array}{rcl} \text{Energy to be} & = & \text{Energy required} \\ \text{supplied by ration} & & \text{by animal} \\ \\ \text{Energy for} & + & \text{Energy for} \\ \text{maintenance} & & \text{production} \end{array}$$

For example, using this approach and standards established through the years, a dairy cow weighing 1,000 pounds and producing 60 pounds of 4 percent fat corrected milk would need approximately 27.2 pounds of total digestible nutrients (TDN) daily to meet the requirements for production and maintenance (Figure 1). This represents the energy contained in 36.2 pounds of grain or 49.4 pounds of average hay. Most 1,000-pound cows cannot eat 49 pounds of hay. The hay intake is not likely to exceed about 30 to 35 pounds. As shown in Figure 1, the energy supplied from forages decreases as the quality decreases; consequently, the energy supplied from grain must be increased if production levels are to be maintained.

Although the TDN requirements are different for dairy cattle, beef cattle, sheep, and horses, the principle shown in Figure 1 is the same for all types of livestock.

The effect of forage quality on forage dry matter intake, dry matter digestibility, and the milk potential of the forage is presented in Figure 2. As forage quality decreases, forage intake and nutrients supplied by the forage also decrease, and the milk production potential will approach zero, as is indicated for poor quality forage in Figure 2.

Considering the poor quality of the forage used on many farms, it becomes evident why dairy producers and beef cattle feeders depend heavily on grain to produce milk and meat. On most farms, a material saving in the cost of producing livestock and livestock products could be made by feeding more high quality hay and less grain per animal unit. If the fullest use is to be made of an animal's capacity for utilizing forage, this forage should be palatable and nutritious, for a ton of high quality forage supplies more digestible nutrients

Prepared by Les Vough, former Extension agronomist,  
Oregon State University.

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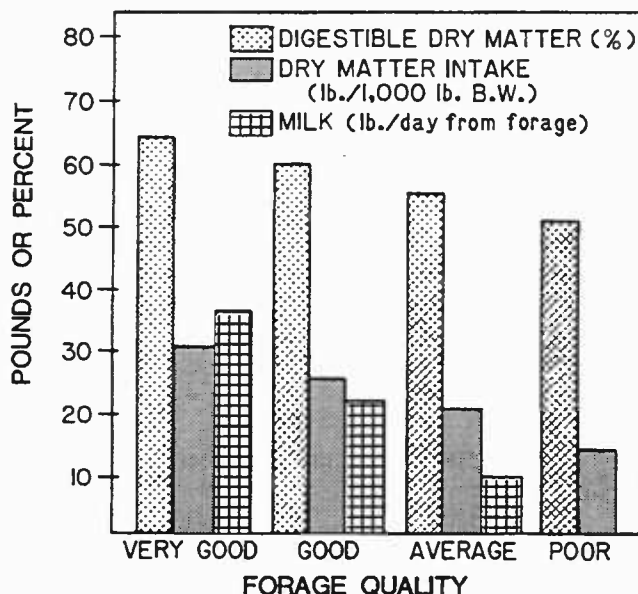
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Figure 1. Forage quality and grain required (1,000-pound cow producing 60 pound 4 percent fat corrected milk).

REQUIRED	MAINTENANCE 8.0 lb. TDN	MILK 19.2 lb. TDN	GRAIN NEEDED (lb)
SUPPLIED BY FORAGE			
VERY GOOD	FORAGE 19.5 lb. TDN	DEFICIT 7.7 lb. TDN	10.3
GOOD	FORAGE 15.0 lb. TDN	DEFICIT 12.2 lb. TDN	16.5
AVERAGE	FORAGE 11.0 lb. TDN	DEFICIT 16.2 lb. TDN	22.0
POOR	FORAGE 7.5 lb. TDN	DEFICIT 19.7 lb. TDN	26.2

Source: Adapted from Forage to the Front. Ag. Ammonia News, May-June, 1964.

Figure 2. Effect of forage quality on digestibility, dry matter intake, and milk production from forage.



Source: Adapted from Forage to the Front. Ag. Ammonia News, May-June, 1964.

than a ton of low quality forage of the same kind. An animal's appetite may be satisfied with low quality forage before it gets enough nutrients from the forage portion of the ration to fulfill its requirements.

### Determining the quality of forage

There are two principal methods that you can use to determine forage quality. One is to sample the hay and/or silage to be fed and have it chemically analyzed. This analysis can be obtained from the Forage Analytical Service at Oregon State University or at any of a number of commercial laboratories in Oregon and surrounding states. Your county Extension agent has sampling instructions as well as the appropriate forms to be used when submitting samples to the OSU Forage Analytical Service. Your Extension agent also can help you locate other testing laboratories, and is available for assistance in interpretation of the analysis and in planning more efficient rations.

The second method is visual and one you can do on the farm. It requires judgment based on certain physical characteristics of the forage.

### How do we estimate forage quality visually?

Visual estimates of forage quality are based on factors known to influence hay and silage quality, and animal performance. These factors are stage of maturity, leafiness, color, foreign material, and the odor and condition. Let's examine each one of these factors in some detail.

**Stage of maturity.** This refers to the growth stage of a plant at the time it is harvested. This is an important factor in determining the maximum feed value obtainable from an acre of forage. Early-cut hay is high in feed value. For example, more than twice as many pounds of alfalfa hay cut in the seed stage is required to produce 100 pounds of gain in steers than alfalfa cut in the bud stage (Figure 3). This is because animals eat less of the poorer quality hay per day and will take longer to gain weight.

Total digestible nutrients (TDN), which includes protein, are higher in early-cut hay (Figure 4), as are phosphorus and carotene (the compound from which vitamin A is formed). Note in Figure 4 that alfalfa in the bud stage may have in excess of 20 percent crude protein, while at full bloom the protein content may be only 10 to 12 percent. Alfalfa hay cut at the late bud to very early bloom stage has a potential as high as 65 percent digestible nutrients (Figure 5). The same crop cut at full bloom usually has dropped to 55 percent digestible or less. Thus, late-cut hay is low in feed nutrients.

Comparable figures for grasses are 65 percent TDN and 12 to 15 percent crude protein at the boot stage (head emerging from the leaf roll) and 50 percent or less TDN and 4 to 8 percent crude protein when the bloom is on the grass heads. There is less protein in a hundred pounds of either grass or legume as maturity advances (as the crop becomes older).

The time of cutting also makes a great difference in the palatability of hay or silage. As with digestibility, palatability also decreases as the crop becomes older (Figure 5). This is largely a result of the increasing amounts of fiber found in plants as the crop matures. Figure 6 shows that the average percent crude fiber of alfalfa in the bud stage is 20 percent, while at full bloom the percentage has increased to 35.

A common fault in forage harvest is to delay cutting too long. The quality of many excellent crops of grasses, alfalfa, and red clover is virtually sacrificed because they are not cut early enough. It is impossible to make high quality hay or silage from late-cut grass, alfalfa, and red clover, even with perfect curing weather.

The loss in quality with delayed cutting is not as serious with trefoils (lotus), white clover, and subterranean clover since their quality does not decline as rapidly with advancing maturity as happens with alfalfa, red clover, and the grasses. Trefoils and white and subterranean clovers do not drop the lower leaves as maturity advances, and their stems are finer and softer; thus they do not become as stemmy and unpalatable with maturity.

On a yearly basis, early-cut hay yields as much feed (digestible dry matter) per acre as later-cut hay and provides better livestock performance. Early-cut hays



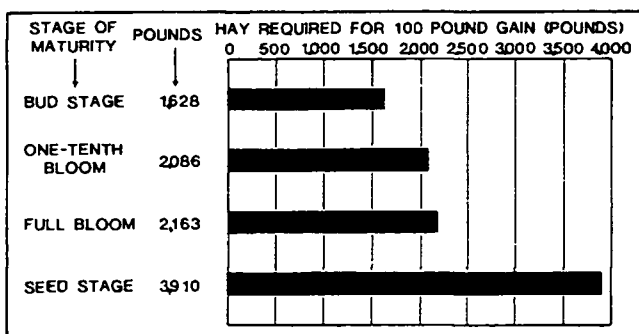
make desirable feed because they contain more digestible material. And because early-cut hays are more palatable, they are eaten in larger quantities by livestock and require less supplementation with grain than later-cut hays.

**Leafiness.** The amount of leaves in relation to stems is a more critical factor with legumes than with grasses because leaf loss during curing and handling is much greater with legumes. Leaves are higher in overall feed value than stems, as indicated by higher TDN, protein, and carotene contents, and a lower fiber content. On the average, alfalfa leaves contain about 24 percent crude protein and 14 percent crude fiber while the stems contain only 10 to 11 percent crude protein and 38 percent crude fiber. In other words, the leaves of alfalfa have about 2½ times as much protein as the stems and are very important in determining feed value. The protein in the leaves is also more digestible than that in the stems.

Since leaves are high in protein and low in fiber, highest quality hay is cut in the bud to early bloom stage when plants have a high proportion of leaves. As the plants mature the stems become larger, lower leaves fall from the plant, and the proportion of leaves decreases (Figure 4), resulting in a decline in protein and an increase in fiber.

The amount of leaves is an important indicator of both feed value and yield in hay.

Figure 3. Gains in weight of steers affected by the maturity of the alfalfa fed.



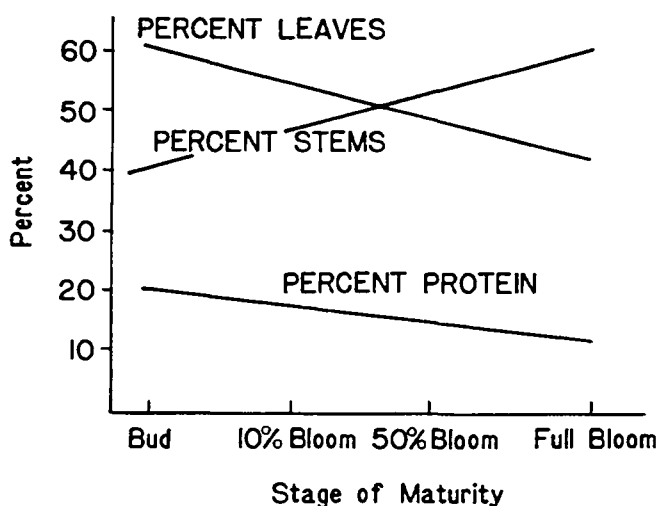
Source: Hay Quality: Relation to Production and Feed Value. USDA Miscellaneous Publication No. 363.

**Color.** This indicator is associated with the nutrient content, especially carotene. Color also indicates how well the hay is cured. The most desirable color approaches that of the bright green, immature crop in the field. This usually is associated with early cutting, good curing, pleasant aroma (odor), high palatability, freedom from must or mold, and a relatively high carotene content.

Any change in color indicates a reason for loss in feed value:

- Yellowing usually indicates more mature hays.
- A light golden yellow or bleached appearance may be a result of bleaching by the sun or it may indicate that rain has leached (washed) out some of the most digestible nutrients.
- Brown indicates heating caused by storage of high-moisture hay. Brown hay usually has a distinctive odor and the baled hay usually is caked.
- Blackening indicates excessive rain damage—spoilage of plant tissues after curing.

Figure 4. Effect of stage of maturity on average percent leaves, stems, and alfalfa protein.



Source: Management of Irrigated Forages in Nevada. Nev. Agr. Exp. Sta. Buil. B29.

Brown or black hay is an indicator of considerable losses in dry matter, vitamins, and digestibility (especially digestibility of protein). The presence of the dull gray of mildews and molds indicates that the hay was stored at too high a moisture content. Such hay also has lost dry matter and quality.

**Foreign material.** Hay can contain non-injurious and injurious material. Non-injurious foreign material describes all kinds of matter commonly wasted in feeding operations, but that is not harmful to livestock if eaten. This includes weeds, so-called wiregrasses, overripe grain hay, grain straw, cornstalks, stubble, chaff, sticks, certain grasses if mature, and any other objectionable matter that might occur in the hay. Some of the grasses that are considered as foreign material when mature are wild rye, most annual bromegrasses such as cheat and chess, pigeon grass (sometimes called foxtail or wild millet), broomsedge, and needlegrasses from which the needles have fallen.

Material that will cause injury or that is poisonous when eaten by livestock is considered injurious foreign material. This includes sandburs, poisonous plants such as tansy ragwort, harsh or rough bearded grasses like mature foxtail, wild barley, 3-awn grass, or rigput brome, and grasses that have a sharp point at the base of the seed (matured needle grasses with the needles attached). It also includes any other matter such as wire or nails.

Hay containing weeds or other foreign material is discriminated against on the market because weeds represent waste and give the hay a bad appearance. Weeds are objectionable for feeding purposes because the weed seeds usually pass through the animal undigested and when the manure is spread on the land, it becomes a source of weed infestation. Many noxious weeds are spread in this way.

**Odor and condition.** The aroma of new-mown hay is the standard with which all odor comparisons should be made. Any other odor, such as mildewy, musty, or putrefied (rotten), indicates lowered quality. Storage at too high moisture and weather damage cause odor problems and result in lowered acceptability to livestock.

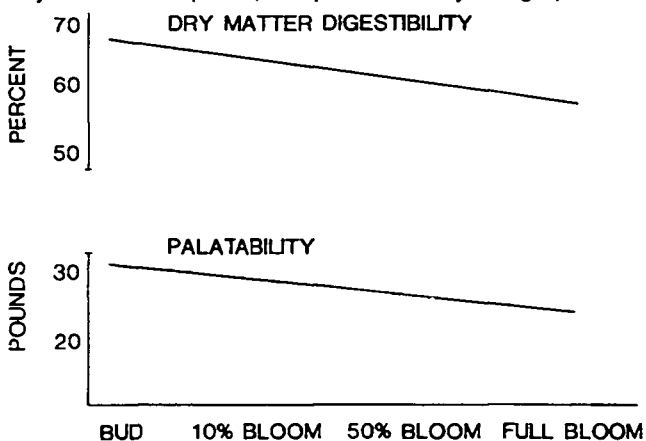
Attention also should be given to the condition of the hay. It should be free from must and mold, as well as free from insect and disease damage. It also should not be dusty.

### Combining chemical and visual analyses

A visual evaluation supported by chemical analysis is the most reliable indication of quality. Chemical analysis gives a reliable measure of the items determined, but a visual estimation reveals quality factors such as spoilage, foreign material, and leaf shattering or loss. Chemical estimates do not show these factors.

Visual examination alone, while very useful, creates problems for livestock producers, particularly those who purchase their forage requirements and desire a consistently high quality product. For example, a sampling of five lots of hay that appeared to be almost identical showed a wide range of quality as determined by chemical analysis. The percent crude protein in these lots was 19.7, 17.7, 15.3, 11.7, and 13.7. Whenever possible, chemical analysis should be combined with visual estimation.

Figure 5. Effect of stage of maturity of alfalfa on average dry matter digestibility and palatability (pounds of hay consumed per 1,000 pounds body weight).



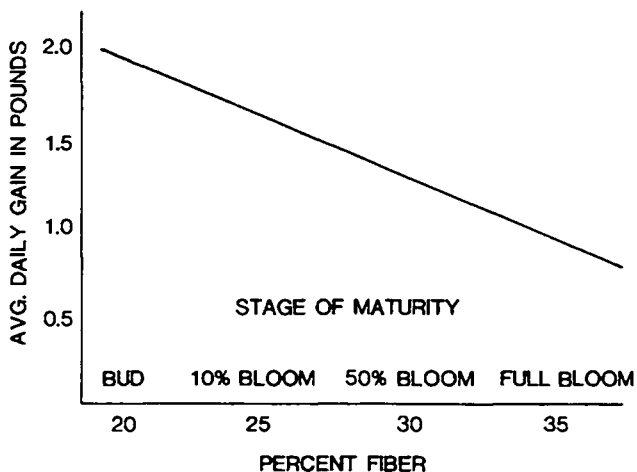
Source: Management of Irrigated Forages in Nevada. Nev. Agr. Exp. Sta. Bull. B29.

### Summary

Forage quality generally means feed value and is dependent upon the availability of nutrients (chemical composition) and the amount of forage consumed (rate of intake). A number of factors are known to influence forage quality and animal performance, the most important of which is stage of maturity. Top quality forages are cut early. Alfalfa should be cut in the late-bud to early-bloom stage; clovers, 25 to 50 percent bloom; and grasses, in the boot to early heading stage. Treat alfalfa-grass mixtures as alfalfa, and clover-grass mixtures as grass. Top quality forages also are leafy, bright green in color, and free from weeds, mold, or mustiness. They are high in protein, energy, digestibility, carotene, and minerals, and low in fiber.

Forage varies more in quality than any other harvested feed crop grown on American farms. There is a wide variation in forage quality, even within a single species grown in almost identical conditions. This variation is due largely to a lack of understanding of the fundamentals of good haymaking and to a tendency

Figure 6. Effect of maturity stage of alfalfa on average percent crude fiber and estimated daily gains of a 500-pound calf on full feed.



Source: Management of Irrigated Forages in Nevada. Nev. Agr. Exp. Sta. Bull. B29.

among farmers to give less attention to their hay crop than to their livestock or to crops such as wheat and potatoes.

Characteristics of high quality forage have been emphasized throughout this discussion; however, this does not mean that all livestock should be fed only the highest quality forage. A substantial portion of the ration for maintenance of dry beef and dairy cows, dry ewes, and mature horses can consist of low and medium quality forages. These animals can make the best use of lower quality forages. Young, growing animals and high-producing milk cows have higher nutrient requirements and should receive the higher quality forage.

Knowing the nutrient requirements of the livestock to be fed and the nutrient contents of the forage available for feeding, the livestock producer can formulate balanced rations using combinations of forages with varying quality levels or combinations of forages and protein and/or energy supplements. Low quality hay often can be supplemented with several pounds of high quality hay, saving the cost of concentrate feeds. Hay buyers will frequently find both excellent and poor quality hays are offered at the same price. Knowing the higher quality feed also can save you money.

The quality of forage fed to livestock determines how far you can cut expensive concentrates to minimize costs and maximize profits. Livestock feeders seeking profits consider good quality forage as the basis of any livestock ration; low quality forage, lacking in essential nutrients, must be supplemented with expensive concentrates. Substantial savings in the cost of producing livestock and livestock products could be made on many farms by feeding more high quality hay and less grain per animal unit.

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# Tips for Teaching Forage Quality

## Leader Guide

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any teaching methods can be used in studying the meaning and importance of forage quality and the factors to be considered in the evaluation of forage. Members should understand the importance of forage quality in livestock feeding programs before evaluating hay.

The principal objective of this program is to gain practical knowledge; winning a judging contest is secondary and is one of the learning methods. As a 4-H leader, you should stress the five physical factors that determine quality: stage of maturity, leafiness, color, foreign material, and odor and condition. Place particular emphasis on stage of maturity since it is the most important factor determining quality. These presentations would be appropriate for club meetings held during the winter or early spring.

Subsequent meetings could include quizzes on background material to reinforce members' understanding of

quality factors. In late spring and early summer, schedule field trips to various hay fields to look for stages of maturity in grasses and legumes. Stage of maturity is more easily identified before the crop is cut. Seeing the different stages in the field also will help in identifying them in the bale.

In the first few training sessions in which members will evaluate hays, it may be helpful to have them use a score sheet. Use a separate sheet for each hay sample. Members can then compare their scores for each sample and discuss their evaluations. Any score given to a sample is a matter of judgment. It is an estimate of feed value based on indicators of acceptability to the animal. But the use of a score sheet is not required in a contest.

As members become more proficient in their evaluation skills, club activities might include practice judging sessions and contests within the club as well as between clubs, and at county and state fairs.

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### How to obtain samples

If possible, obtain samples from hay that has been chemically analyzed. Chemical analysis (crude protein, acid detergent fiber, etc.) can be used to confirm your visual evaluation when selecting samples for contest classes. Chemical analysis also is helpful in settling arguments and disputes in a contest if members disagree with your official placings.

Possible sources of samples are:

- Parents of club members.
- Hay producers in your area.
- Dairy farmers in your area, especially those who buy large quantities of hay.

- County fairs that sponsor a hay judging contest. They may be willing to give you the material when the fair is over.
- Farm co-ops and marketing organizations handling hays.
- County Extension agents may be able to direct you to possible sources.
- Material exchange with other 4-H clubs. When you locate a source, obtain enough material for several samples and work cooperatively with other clubs.

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Since visual analysis will be the most difficult part of judging hay samples, you may want to begin your training program with samples the members bring. In the first sessions, have samples for the members to pull apart and closely examine. Members should look for stage of maturity, leafiness, color, foreign material, and odor and condition of samples. Save the "analysis" samples for later stages of the training program when members will be able to evaluate samples without tearing them apart. This will allow you to reuse the samples since these may be more difficult to obtain than are the non-analysis samples.

Remember that chemical analysis is a tool to assist you in setting up your training sessions. It can be used as a method to check and prove the accuracy of your visual evaluation when you assemble hay samples for your training activities.

In obtaining samples, try to get a range from excellent to very poor quality hays. Obtain samples of hay that have been rained on several times, are nearly black, are mostly stems, and are musty or moldy. Include samples that have some weeds or other foreign material. The greater the variety of samples, the better the learning experience for the club members.

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## Setting up an evaluation session

A class consists of four samples. Try to include at least one excellent and one poor sample in each class so that there are obvious differences. Examples of different ways in which classes can be made are:

- An excellent quality sample for first place and a poor quality sample for last place. The decision between the remaining two samples for second and third places should be more difficult.
- Obvious third and fourth place samples, with the decision between the remaining two samples for first and second place being more difficult.

- Obvious first and second place samples, but the decision between the third and fourth place samples being more difficult.

Do not mix two different kinds of hay in the same class. A class should consist of only one kind of hay, such as alfalfa, clover, grass, or alfalfa-grass hay (mixture of alfalfa and grass in the field).

When collecting samples, get as much information as you can about them. The more information you obtain about the date of harvest, stage of maturity when cut, or rain damage, the less guesswork later.

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Prepared by Les Vough, former Extension agronomist; and Duane Johnson, Extension specialist, 4-H youth development; Oregon State University.

# How To Set Up a Plant Identification Contest

## Leader Guide

Plant identification contests are helpful in stimulating interest and reinforcing the learning experience. The contest need not be difficult or involved to achieve its objectives. The following suggestions will be helpful in setting up a contest.

Leaders should select and use only plants observed on tours or discussed at club meetings. Plants in county contests should be selected from a list such as the one for the Plant Identification Contest at the State Fair.

Plants are more difficult to recognize out of their natural surroundings. A tall fescue plant can easily be recognized in a pasture but is more difficult to identify as a dried mount or as a single plant on a table.

Essential parts of the plant (leaf, root, rhizome, stolon) must be present for identification. A flower and/or seed head should also be included if possible. Plants selected for identification contests should appear normal or have a natural growth habit.

Fresh plants are preferred over pressed specimens because of their natural appearance. They can be brought directly from the field to the contest. If plants must be held for some time or if the weather is extremely warm, they can be wrapped in damp towels or placed in water to keep them fresh. Plants will remain in a natural condition for several days if potted in gallon cans filled with wet sand.

Pressed specimens can be used for plants that are not seasonally available. Dried plants are more difficult to recognize, and club members should be familiar with the characteristics used in identifying pressed plants.

Contests in plant identification should include a few seeds of cereals and cultivated plants. Seed collections in numbered glass vials can be used for review or a contest.

An important part of any contest activity is a review of the judging class after the contest is completed. Participants should have an opportunity to go through the class of plants and discuss the identification and characteristics used to identify particular plants. This is helpful in reinforcing the learning experience and provides an opportunity for learning about new plants.

*Prepared by Harold Youngberg, Extension specialist emeritus, Oregon State University.*

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# Plant Identification Illustrated Glossary

## Leader Guide

Plant identification keys and descriptions use certain terms that are very specific in their meaning. These unfamiliar words may make these keys appear more difficult than they really are. No one masters a trade without learning the names of the tools. Ligule, sheath, and collar are words no more difficult to learn than are sparkplug, windshield, or mainspring.

Botanical terms are used for the same reason that names are given to different parts of an auto-

mobile; the terms are simpler and more exact than long descriptive phrases. It is simpler to say *sparkplug* than it is to say "the little porcelain thing that screws into an engine block," and it is simpler to say *ligule* than to say "the little thin scale attached to the inside of the bottom of a grass blade."

The following terms are used commonly in plant descriptions and plant keys. The list does not include *all* the terms necessary to make a career as a botanist, but it is a good introduction.

### General Terms

**Acute**—Ending sharply and abruptly in an angle of less than 90°.

**Annual**—A plant that completes its life cycle from seed germination to seed production and death within a single year or growing season.

**Axis**—The main stem of a flower or panicle.

**Biennial**—A plant that germinates and remains vegetative the first year then flowers, fruits, and dies the second year.

**Compound leaf**—A leaf divided into two or more parts, or leaflets.

**Entire**—Without teeth, lobes, divisions, or any marginal cutting; having a smooth and uninterrupted, flowing outline.

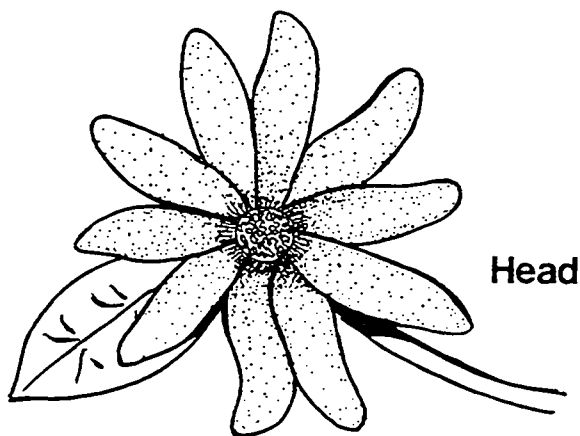
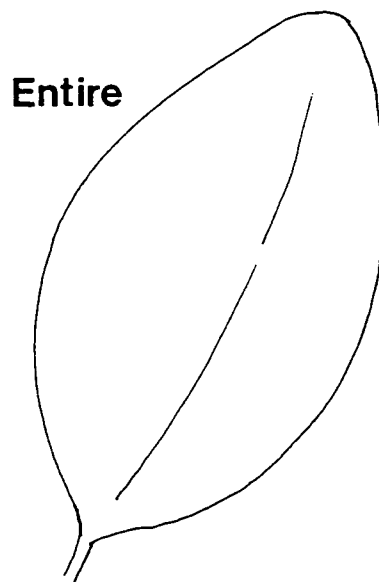
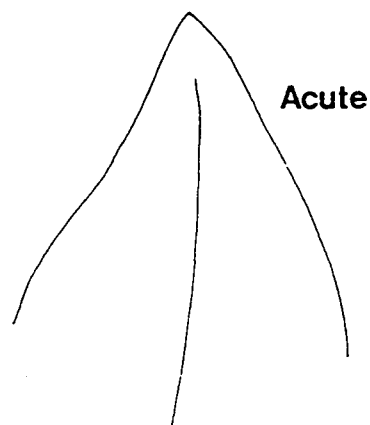
**Head**—A dense roundish cluster of sessile or nearly sessile flowers on a very short or flattened floral branch, as in red clover or sunflowers.

**Inflorescence**—The flowering part of the plant.

**Internode**—The part of a plant stem between the joints or nodes.

**Leaflet**—A single division of a compound leaf.

**Node**—The enlarged, solid portion of the stem or culm forming the joints; point of attachment for leaves and branches.



**Ovate**—Egg-shaped, the broader end near the petiole or stalk.

**Panicle**—Inflorescence with a main stem (axis) and sub-divided branches. In grasses the panicle may be compact and spike-like (timothy) or open (orchardgrass).

**Pedice**l—The stem of an individual flower.

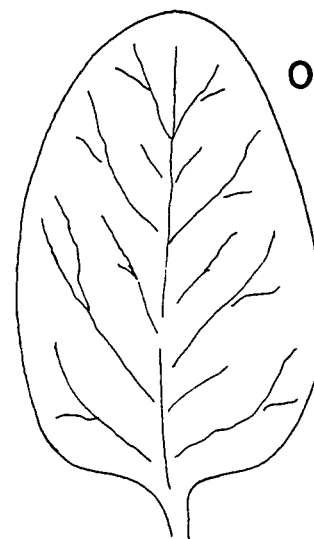
**Perennial**—A plant that lives for 3 or more years.

**Petiole**—Stalk by which a leaf blade is attached to the plant stem.

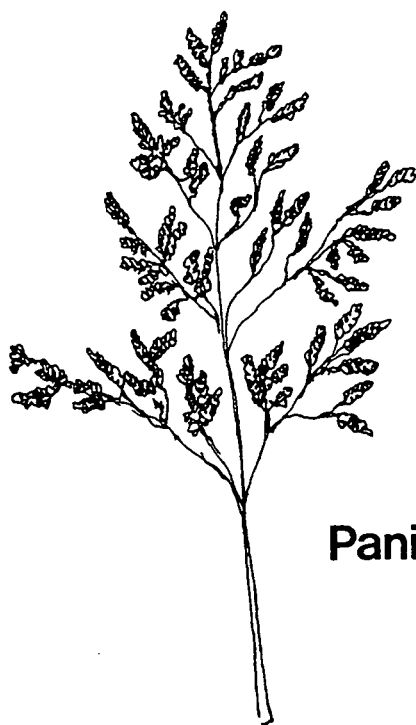
**Pubescent**—A general term meaning hairy; specifically, however, the term means downy haired; covered with fine, soft, short hairs (pubescence).

**Raceme**—An unbranched inflorescence in which the individual flowers are borne on stems (pedicels) along a central axis.

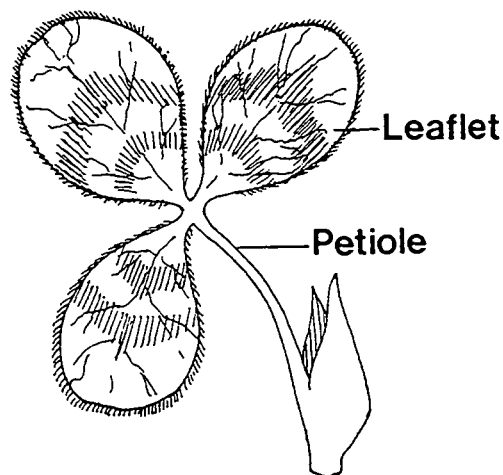
**Rhizome**—An underground stem, usually horizontal in position. Distinguished from a root by the presence of nodes and internodes. Capable of producing new shoots and roots at the nodes.



Ovate

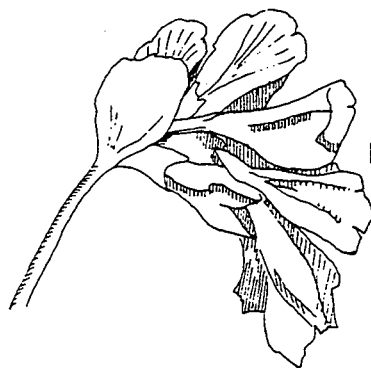


Panicle

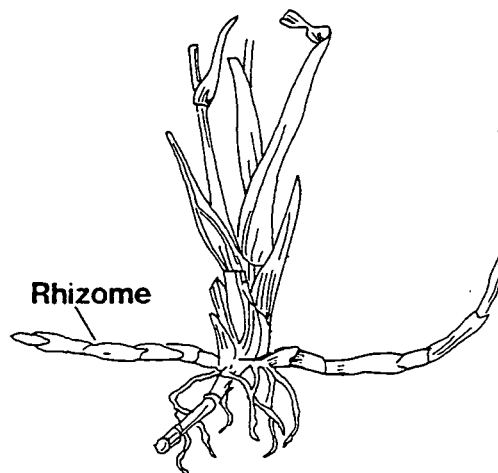


Leaflet

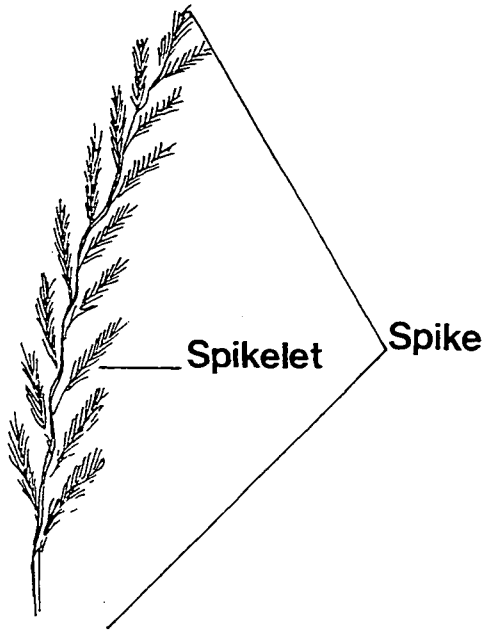
Petiole



Raceme



Rhizome



**Serrated**—Saw-toothed; having sharp, forward- or upward-pointed teeth.

**Sessile**—Without a stalk or pedicel.

**Spike**—An unbranched inflorescence in which the individual flowers are attached directly to the central axis, such as wheat and barley. Resembles a raceme except that the flowers are sessile.

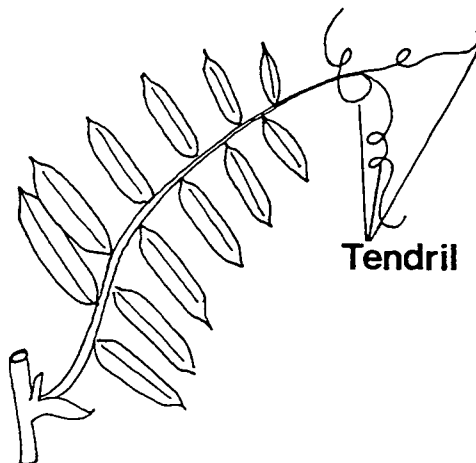
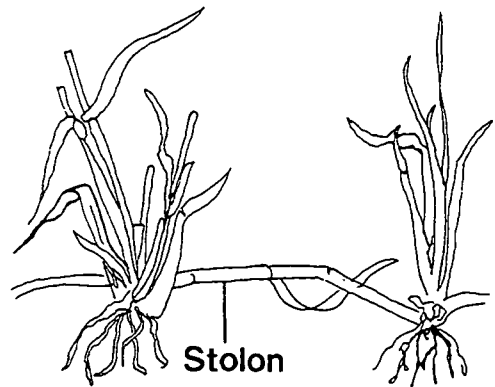
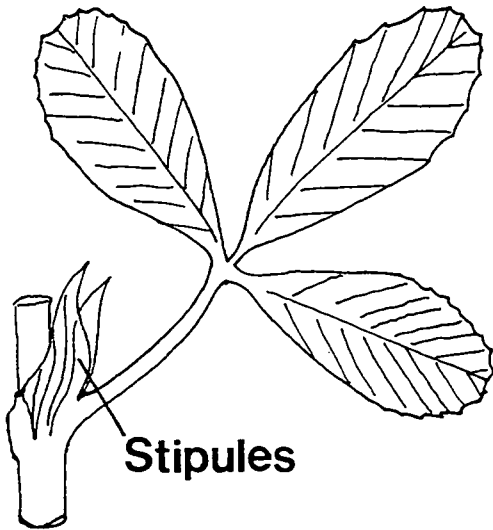
**Stipule**—A leaf-like appendage at the base of the petioles of some species of plants; often united.

**Stolon**—A prostrate or creeping stem, generally above ground, capable of rooting and sending up new shoots at the nodes. May be called a runner, as in strawberries.

**Tendrils**—A leaflet or stem modified for climbing or anchorage, as in the pea.

**Trifoliolate**—Having three leaflets; the leaves three-divided, as in clover and alfalfa.

**Veins**—The ribs or vascular bundles which form part of the framework (skeleton) of a leaf; so called because of a resemblance to human veins.





Plants closely related in physical characteristics are grouped together in families. These families have particular terms that are used to identify various parts of the plants. The following terms are necessary to describe plants within the grass family.

### Grass Family (*Gramineae*) Terms

**Auricle**—Small claw or ear-like outgrowths at the junction of the leaf blade and sheath of some grasses; presence or absence varies with the species.

**Awn**—A slender bristle-like projection extending from the back or tip of the lemma of a grass flower; presence or absence varies with the species and the variety.

**Bunchgrass**—A grass that grows in clumps. It has no prominent stolons or rhizomes.

**Collar**—The area on the outer side of the leaf at the junction of the leaf sheath and the blade.

**Culm**—The stem or stalk of grasses. These stems are jointed and hollow or pithy.

**Glume**—One of the pair of empty chaffy bracts or husks at the base of the flower (spikelet) of grasses.

**Internode**—The part of a plant stem between the joints or nodes.

**Leaf blade**—The expanded or broader portion of the leaf which is above the sheath and usually extends outward from the stem.

**Leaf sheath**—The lower part of the leaf that encloses or surrounds the stem. Sometimes called the "boot."

**Lemma**—The lower (and larger) of the two bracts enclosing the flower (spikelet) of grasses.

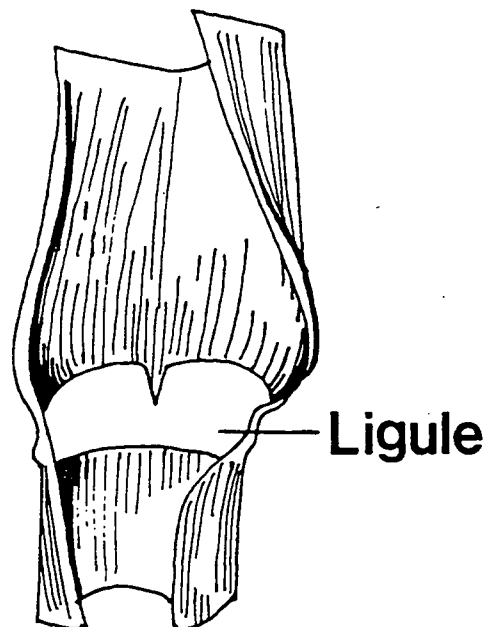
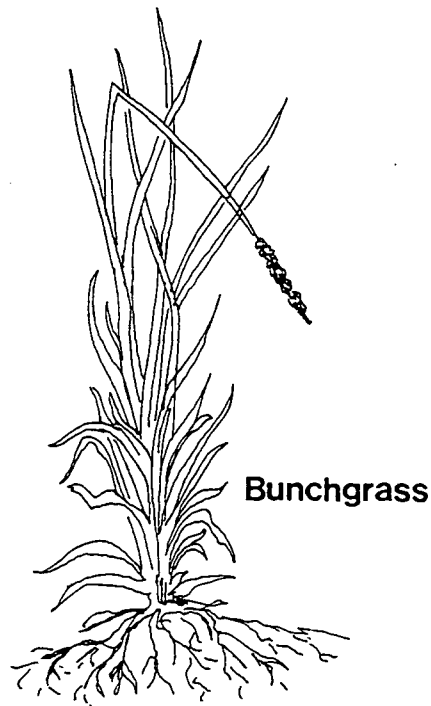
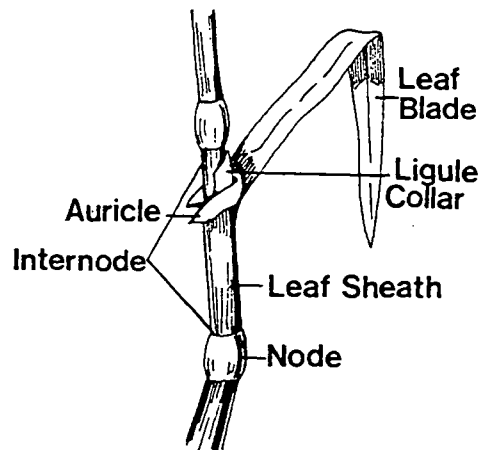
**Ligule**—The projecting outgrowth on the inside of the leaf where the sheath and blade join; often membranous or occasionally a ring of hairs.

**Node**—The enlarged, solid portion of the stem or culm forming the joints; point of attachment for leaves and branches.

**Spikelet**—The unit of the grass flower-head or inflorescence generally composed of two glumes and one or more flowers.

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Prepared by La Rea Dennis Johnston, senior instructor emeritus in botany; Richard Lawson, former graduate assistant in crop science; Les Vough, former Extension research agronomist; and Harold Youngberg, Extension agronomist emeritus; Oregon State University.



# Collecting, Preserving, and Mounting Plant Materials

## Leader Guide

Pressed and dried plant specimens are useful as teaching aids and reference sources for plant identification, or as decorative material. Select plants to be mounted with care, prepare properly, and accompany by adequate, clearly expressed, written identification data. This publication suggests materials and methods for selecting and preparing plants for mounting.

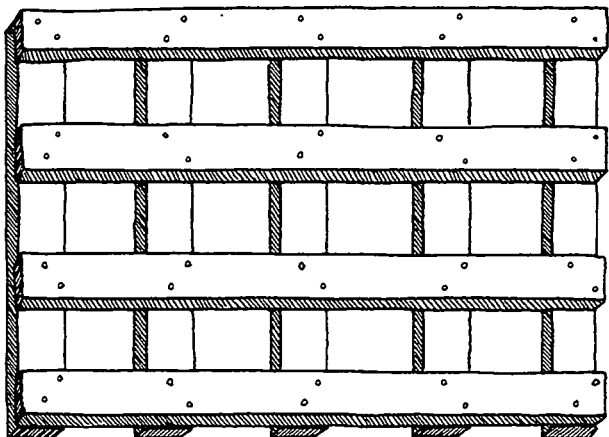
### Equipment

1. A plant press, consisting of two hardwood frames plus straps, corrugated cardboard, blotters, and newspapers.

If you do not already have a plant press, you can construct one using the materials listed. Each press requires two frames. For each frame you will need:

- Four smoothly finished wooden lath or strips  $\frac{1}{4}$  inch by  $1\frac{1}{2}$  inches by 16 inches.
- Five smoothly finished wooden lath or strips  $\frac{1}{4}$  inch by  $1\frac{1}{2}$  inches by 12 inches.

Arrange strips as shown in drawing. Nail or rivet securely at each intersection of the strips, thus forming a rectangular frame 12 inches by 16 inches.



- A pair of 3- or 4-foot straps about 1 inch wide. Window sash cord with a loop tied in one end is also satisfactory.

- At least two (preferably more) pieces of corrugated cardboards, 12 inches wide and 16 inches long, with the corrugations running crosswise.

- Blotters (15 or more, depending on number of plants to be pressed) 12 inches by 16 inches cut from heavy blotting paper or from lightweight builders' deadening felt. If possible, keep extras on hand to rotate with dry blotters during the drying process.

- Newspapers folded to 12 inches by 16 inches.

2. A pocket-size notebook.

3. A digging tool such as a small shovel or trowel for digging roots.

4. Pruning shears, clippers, or a sharp knife for cutting branches of woody plants and trimming specimens.

5. "Herbarium Sheets." A standard botanical mounting paper is  $11\frac{1}{2}$  inches by  $16\frac{1}{2}$  inches, made of poster board. You can buy these at a stationery store or have a printer cut a supply for you.

### Collecting plant specimens

To obtain typical specimens collect from areas with at least 10 other plants of the same species in sight.

Complete and typical specimens should be collected. Select specimens to illustrate as complete as possible the various parts of the plant. If at all possible, collect material in the flowering and/or fruiting condition.

- For small herbs, collect the whole plant or several plants, including underground parts.

- With larger herbs, take representative parts of both the upper and lower portions of the plant. Describe the basal parts, if not collected, in your notes.

- For woody plants, take a typical branch, bearing fertile material whenever possible. Cut branches rather than breaking them. Sometimes a piece of bark is desirable for identification.

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The quantity of material collected should moderately fill a standard 11½ inch by 16½ inch herbarium sheet.

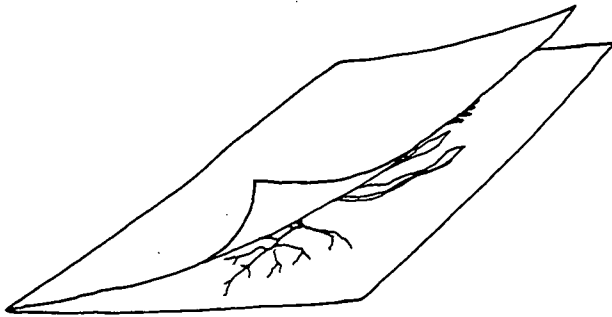
In cool weather, you can carry collected specimens in plastic bags for some time without wilting, especially if they are sprinkled with water or wrapped in moist newspaper and the bags closed with elastic bands or wire ties. Put material from one collection only (plants that appear to be all alike and all from one location only) in one bag. In hot summer weather, place plants in a press directly upon collection.

Record appropriate notes in the field at the time of collection to assure accurate and complete information. Notes on habitat, abundance, color of flowers and fruit (they often change color upon drying), and associated species in the area are important for study and identification of collected specimens. Do not rely on your memory!

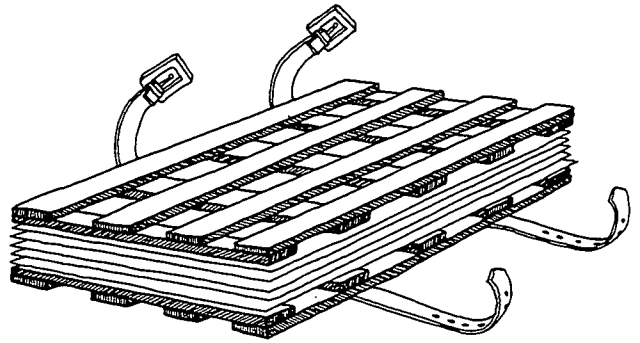
A notebook is useful for recording information. Give each specimen a number, record the number, date, and collecting information in your notebook. Place corresponding numbers in the plastic bags and on the newspapers in which the specimens are pressed.

#### Pressing and drying plant specimens

To press the plants, arrange them on the open half of a folded newspaper, as naturally as possible. Avoid excessive overlapping of plant parts, and see that leaves are not unnecessarily crumpled or folded. Mark the same identification number on the newspaper as recorded in your field notebook.



Build up the press by starting with one of the press frames on the bottom. Turn the frame so that the long strips are on the outside to prevent pulling the press apart and to insure uniform pressure when the press is strapped. Lay a corrugated cardboard over the frame, following this lay a blotter, then the folded newspaper in which the plant specimen is spread, then another blotter. Blotters absorb the moisture from the plants. Repeat this sequence (blotter, folded newspaper with contained plants, blotter) until all specimens are arranged. An occasional cardboard scattered throughout the press may be helpful. Top the pile with another corrugated cardboard and the second press frame



(long strips on outside). Strap together very tightly with two straps or two pieces of rope (window sash). Pressure should be even. Maintain pressure by tightening the straps or rope as drying progresses.

Colors are retained more naturally if specimens are dried quickly. Open the press and inspect the specimens twice daily at the start. If the blotters are moist, change them. Spread the damp ones out in the sun to dry or dry them over a radiator or other heat source. The blotters absorb moisture from the plants and consequently may become very moist within a day's time. Moist blotters should be changed or dried every day until the plants are dry. Leave the specimens stacked in their newspaper unless these sheets are also wet, in which case, replace them too. (Be sure to transfer any numbers recorded on the newspaper.) The press should be reassembled as soon as dry blotters are available. Most plants dried in this manner take 4 to 6 days to dry.

Artificial heat can be used to hasten drying, which helps prevent mold or mildew, retains better color in foliage and flowers, and requires less work and press equipment. A portable, fan-equipped electric heater makes a very good drier, since it supplies continuous, gentle, circulating warm air through the tubes of the corrugated cardboard. When using artificial heat, cardboard should be used between each layer of plant material, in this order: cardboard, blotter, folded newspaper with contained plants, blotter, repeating the sequence until all specimens are arranged. Lay the press on its side on an elevated rack 1 or 2 feet above the heater (with the corrugations in the cardboards in vertical position). Two chairs or stools, set apart, make an adequate rack. Foil or some other deflective device may be hung from the bottom of the press to the floor to force the air upward, through the corrugations. With this system, plants may take only 24 hours to dry and the press need not be dismantled to take out, dry, and replace the blotters.

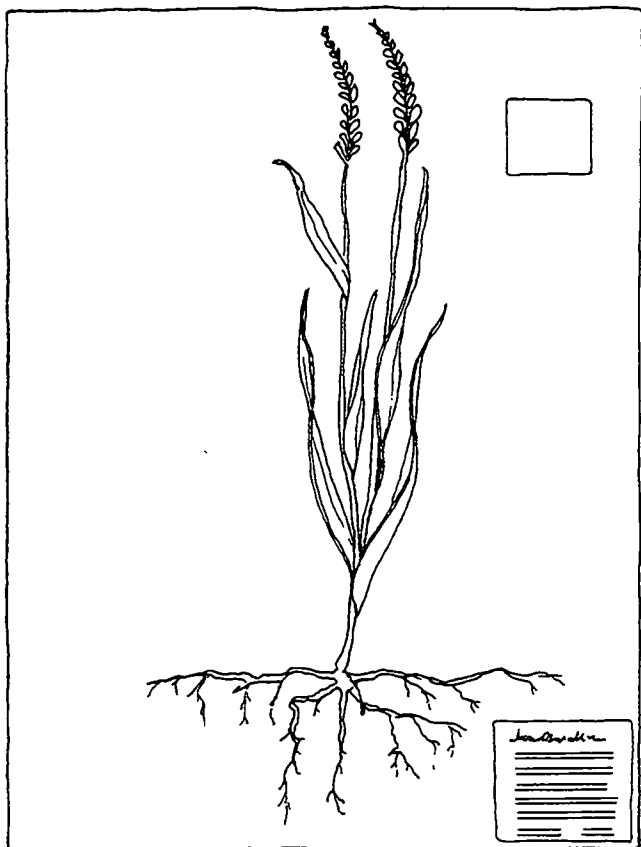
Tighten straps or ropes occasionally during the drying process so that specimens do not wrinkle.

## Mounting plant specimens

Where specimens are handled frequently, mounting will help prevent breakage. Also, some collectors may want to mount dried specimens for wall or counter display.

1. Use standard botanical mounting paper (11½ inches by 16½ inches) of medium weight. If mounting paper is not available, stiff white paper or poster board can be used.

2. Specimens should be glued with a white casein liquid glue. The glue should spread freely and be clear when dry. Do not use clear musilage or paste. Place a coating of glue on the under side of the dried specimen. Then place it on the sheet as desired. Cover the specimen with waxed paper and apply even pressure over the entire sheet until the glue dries. Be as neat as possible.



Specimens may be held in place by the use of transparent acetate tape rather than glue. Making mounts using tape may be quicker, but the tape has a shorter life than the glue. Do not use the common, clear pressure-sensitive tape because it will deteriorate, become sticky, or dry out with age. If you use tape, apply it in several places to hold the entire specimen firmly to the sheet.

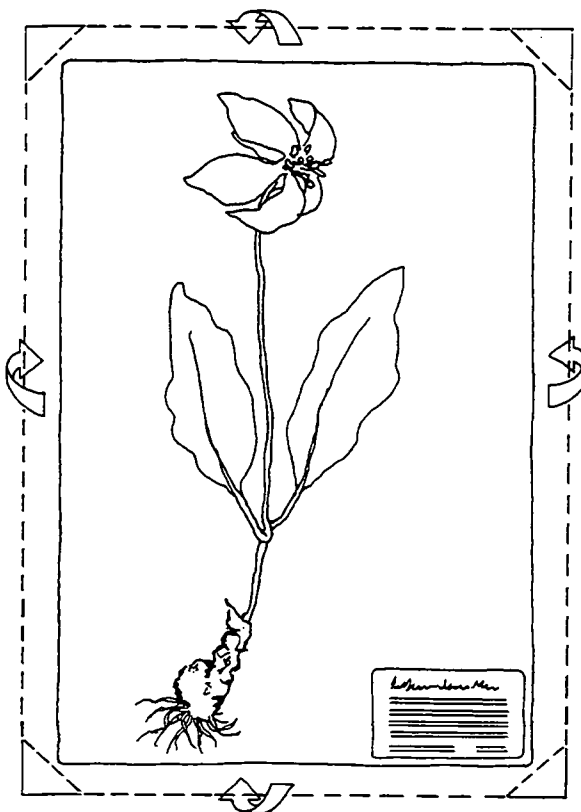
3. Place extra flowers, fruits, seeds, or other loose plant parts in an envelope or glue to an unoccupied portion of the sheet.

4. Glue a permanent label about 3 inches by 5 inches to record all the pertinent information (from the notebook) on the lower right-hand corner of the mounting sheet, or print the information directly on the sheet in the lower right-hand corner. This is a suggested format.

Common name:	
Scientific name:	
Location:	
Habitat:	
Comments:	
Collector:	Date:

5. Once mounted, the specimen can be covered for protection. A stiff, clear plastic sheet, the same size as the mounting paper works best. Place plastic over the mounted specimen and tape all four edges the entire length of the sheet. Use tape ¾- or 1-inch wide and place one half of the width of the tape on the plastic, then binding the rest to the back of the mounting sheet, thus holding the sheets together.

Clear, pressure-sensitive "contact" paper also can be used to protect the specimen. Contact



paper should be about 2 inches longer and 2 inches wider than the mounting paper. After applying the contact paper to the mounted specimen, cut off the corners of the contact paper, fold it over and bind it to the back of the mounting paper in similar manner as for the tape. In this case, it is not necessary to glue the specimen to the mounting paper, as the contact paper will secure the

specimen. Contact paper is much easier to handle if two people can work together.

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Prepared by La Rea Dennis Johnston, senior instructor emeritus in botany; Les Vough, former Extension research agronomist; Richard Lawson, former graduate assistant in crop science; and Harold Youngberg, Extension agronomist emeritus; Oregon State University.

# What to Look for in Evaluating Hay

## Leader Guide

Evaluating hays can teach you a great deal about factors that affect the feeding value of hays as well as the defects that are likely to appear. Top quality hay is associated with high protein and high total digestible nutrients (TDN) contents. The quality of forage fed to livestock determines how far you can cut expensive concentrates to minimize costs and maximize profits. Livestock feeders seeking high profits consider good quality forage the basis of any livestock ration because essential nutrients not supplied by the forage must be supplemented by expensive concentrates.

Hay varies more in quality than any other harvested feed crop grown on American farms. There is a wide difference in the quality of hay, even within a single species grown in the same locality and under almost identical conditions. This variation is due largely to lack of understanding of the fundamentals of good haymaking and to a tendency among farmers to give less attention to their

hay crop than to other cash crops such as wheat and potatoes. Hay buyers will frequently find both excellent and poor quality hays offered at the same price. Substantial savings in the cost of producing livestock and livestock products could be made on most farms by feeding more high quality hay and less grain per animal unit.

### How to evaluate hay quality

Hay should be evaluated for characteristics that will affect its value as feed. *Quality in hay really means feed value.* The factors known to influence hay quality and animal performance are stage of maturity, leafiness, color, foreign material, and the odor and condition.

**Stage of maturity.** This refers to the growth stage of a plant at the time that it is harvested. The stage of maturity of legumes and grasses can be easily identified before they are cut, but after the hay is cut and cured it is more difficult. Weathering or sun-bleaching of the hay or delay of the normal development of the flower parts of legumes because of weather conditions complicates the determination of stage of maturity even more.

The stage of maturity at which alfalfa was cut is determined by observing the condition of the bloom and the texture and woodiness of the stems. Alfalfa cut in the bud stage can be recognized by the size of buds at the tips of the stems and by the absence of the purple flower petals. Bud-stage alfalfa also is usually very leafy and the stems are relatively fine and pliable. Alfalfa cut in the early bloom stages has some purple flowers petals and stems that are larger than in bud-stage alfalfa. Alfalfa hay that is cut after it has blossomed has distinctly larger, woody stems, fewer leaves, and a rather stemmy appearance. Alfalfa cut after the full-bloom stage is usually indicated by the large stems, by the presence of seed pods, and by a deficiency of leaves. Alfalfa blooms profusely under certain conditions and sparingly under others, making determination of the exact stage of maturity by the number of blossoms somewhat difficult.

The stage of maturity of clover can be determined by observing the color and condition of bloom and the maturity of the seeds, if any are



present. Clover that was cut no later than the full bloom stage will have numerous heads that show the red or purplish-red blossoms of the red clover, or the pinkish-white or white blossoms of white and subterranean clovers, provided the hay was not weathered while being cured. Clover cut in the full bloom stage will have no seeds, or at most, only a few shrunken ones. A stage between full bloom and full maturity is indicated by the brown color of all the clover heads and the presence of yellowish-brown seeds. Full maturity is indicated by the dark-brown color of the heads and the presence of plump, mature seeds. The first crop of clover often does not produce seed, which will account for the absence of seed in hay that has other appearances of being late-cut. Clovers should be cut at the one-fourth to one-half bloom stage for top quality hay.

The stage of maturity at which grasses were cut for hay can be determined easily by examining the heads. First-cutting orchardgrass, reed canarygrass, and tall fescue should have been cut in the boot (head is emerging from the leaf roll) to early heading stage. First-cutting timothy, perennial ryegrass, and smooth brome grass should have been cut in the early to medium heading stage. If these grasses were cut before full bloom, no ripe seeds will be present and parts of the flower can be seen. Full maturity is shown by the plump brown seeds that shell out easily from the whitish dry glumes or chaff. The stage of maturity of grasses is also related to green color. Even if not weather damaged, grasses with fully ripe seeds usually have yellowish-brown stems and heads and many brown leaves.

Alfalfa-grass mixtures should be cut according to the maturity of the alfalfa; that is, when the alfalfa is in the late-bud to early-bloom stage. Clover-grass mixtures should generally be cut according to the maturity of the grass.

**Leafiness.** The amount of leaves in relation to stems is a more critical factor with legumes than with grasses, because legumes lose their leaves more readily than grasses during curing and handling. Leafiness is extremely important since two-thirds of the protein is found in the leaves.

Leafiness will depend upon the stage of plant maturity. As plants mature, the stems become larger, lower leaves fall from the plant, and the proportion of leaves decreases. Since leaves are high in protein and low in fiber, highest quality hay is that cut in the late-bud to early-bloom stage when plants have a high proportion of leaves.

Leaf shatter during raking and baling is another major cause of reduced quality. This leaf loss is greater as maturity increases. The method of curing, the method of handling the hay from field to storage, and weather conditions during curing and baling also influence leafiness. It must be emphasized that hay must be cut early and carefully cured and handled in order to save leaves.

Leafiness in alfalfa hay, for example, may vary from 65 or 70 percent for very leafy hay, to only 10 or 15 percent for very stemmy hay. A bale of very leafy alfalfa hay has an appearance in which the leaves predominate and cling to the stems. The stems are soft and pliable. Hay that has been so cured and handled that the leaves cling to the stems usually has pliable stems. On the other hand, alfalfa hay which has a low percentage of leaves will appear very stemmy in the bale.

When leaves are off the stems and are loose in the bales, the hay is likely to lose feed value through waste when the bales are opened for feeding.

**Color.** This is another definite indication of hay feed value. The most desirable color approaches the bright green of the immature crop in the field. This color usually indicates that the hay was cut at an early stage of maturity and well cured. The fresh aroma (odor), freedom from must or mold, and a relatively high carotene content add to its palatability and feed value.

The bright green color in hay may be lost by bleaching in the sun, rain during curing, fermentation in the bale, stack, or mow, or because the plants were too mature when cut. Sun bleaching reduces the palatability of hay. Rain will leach a large portion of the plant nutrients.

The appearance of bleached hay will tell much about the cutting and handling methods:

- Sun bleached hay has a *light golden yellow* color and need not be discriminated against as seriously as hay which has been rained on or which has heated in the stack. Only material on the outside of the window or only the sides of the bale exposed to the direct sunlight, will be bleached. The other material should be a bright green.

- Hay which has been exposed to rain or to heavy fog and dews has a characteristic *dark brown or black* discolored appearance. The stems of hay that has been bleached too long in the sun or that has been discolored by rain are usually harsh and brittle.

- *Brown* colored hay indicates heating and fermentation caused by storage at too high moisture. This hay usually has a distinctive musty odor and the bale is often caked.

- *Yellowing*, especially in grass hay, usually indicates that the plants were over-mature when cut. This can be distinguished from sun bleaching in that all plants will have the same yellowish color.

Slight discolorations from sun bleach, dew, or moderate fermentation are not as serious as the loss of green color from maturity, rain damage, or excessive fermentation.



## Visual evaluation of hay based upon factors influencing quality

The sample score sheet below can be used as a guideline for visually evaluating hay. The score sheet indicates the amount of importance to place upon each factor. You will note that stage of maturity is the most important factor, with 30 points being allocated to that factor. Leafiness, color, and odor and condition each receive a possible 20 points, while foreign material has a possible 10 points.

**Foreign material.** These materials can be divided into non-injurious and injurious. Non-injurious foreign material means those kinds of matter in hay that are commonly wasted in feeding operations, but are not harmful to livestock if eaten. This includes weeds, so-called wire grasses, overripe grain hay, grain straw, corn stalks, stubble, chaff, sticks, and any other objectionable matter. Some grasses, such as wild rye, most annual bromegrasses such as cheat and chess, pigeon grass (sometimes called foxtail or wild millet), broomsedge, and needlegrasses from which the needles have fallen, are considered as foreign material when mature.

Material that is poisonous or will harm the animal when eaten is considered injurious foreign material. This includes sandburs, poisonous plants such as tansy ragwort, harsh or rough bearded grasses like mature foxtail, wild barley, 3-awn grass, or ripgut brome, and grasses that have a sharp point at the base of the seed such as matured needlegrasses with the needles attached. It also includes any other matter such as wire or nails. Hay containing injurious foreign material should not be purchased. In a judging contest, a sample containing injurious material should be placed at the bottom of the class.

Weeds are the most common non-injurious foreign material found in hay. They are usually not relished by the livestock and when eaten have little or no feed value. Hay containing weeds or other foreign material is discriminated against on the market because weeds represent waste and give the hay a bad appearance. Weed seeds usually pass through the animal undigested; when the manure is spread on land, it becomes a source of weed infestation.

**Odor and condition.** The smell of new mown hay is the standard for comparisons. Mildew, mustiness or a putrid (rotten) odor indicates lowered quality and are caused from storage at too high moisture or weather damage. Odor problems usually result in lower acceptability by livestock.

Attention should also be given to the condition of the hay. It should be free from must and mold and from insect and disease damage. It also should not be dusty.

### SAMPLE SCORE SHEET

	Possible score	Score given
<b>Stage of maturity</b>	30	.....
Alfalfa should be cut in the late bud or early bloom stage, clovers at one-fourth to one-half bloom. Most grasses should be cut in the boot to early heading stage. These stages of maturity score highest (25 to 30 points). Alfalfa and clovers cut at the full bloom stage or grasses cut between the late heading and full bloom stages score low because they have lower feed value (1 to 10 points).		
<b>Leafiness</b>	20	.....
Hay with a high ratio of leaves to stems and with a high proportion of the leaves attached scores high (15 to 20 points). Stemmy hay and hay with leaves shattered scores low (0 to 5 points).		
<b>Color</b>	20	.....
Hay with a bright green color scores high (15 to 20 points). Golden yellow to yellow colored hays score 5 to 15 points. Dark brown or black colored hays score 0 to 5 points.		
<b>Foreign material</b>	10	.....
Hay with non-injurious foreign material should receive a lower score than that without (0 to 10 points). Hay with injurious foreign material should be disqualified and placed at the bottom of the class with no score.		
<b>Odor and condition</b>	20	.....
Smell of new mown hay scores high (15 to 20 points). Hays with musty or other off-odors score 5 to 15 points. Moldy or unusually dusty hays are scored very low (0 to 5 points).		
<b>TOTAL</b>	100	.....



## Characteristics of excellent, good, fair, and poor quality hays

**Excellent quality.** Legumes cut in the late bud to early bloom stage for alfalfa or one-fourth to one-half bloom stage for clovers; grasses cut in the boot stage. Leafy, bright green color and free from mold or mustiness. High in carotene, protein, minerals, and energy; low in fiber.

**Good quality.** Legumes cut by one-half bloom; grasses cut in the early heading stage. Leafy, good green color and free from mold or mustiness. Hay that is rained on after partly cured can fall into this category if it was cut early. The nutritional value is not as high as excellent quality but good results can be obtained when properly supplemented.

**Fair quality.** Legumes or grasses cut at full bloom. Lacks green color, stemmy, low in carotene, minerals, protein, and energy. High in fiber.

**Poor quality.** Any legume or grass cut after full bloom. Severely weather damaged, bleached, stemmy, lacking leaves, musty, or moldy.

### Using your hay evaluation skills to determine the hay inventory for your farm

The physical characteristics previously described should indicate to you that there is a wide variation in the potential feeding value of hay. You can use your hay evaluation skills to estimate the quality of the hay that you are feeding to your livestock. You may be surprised to learn that the quality of the hay being fed is better than you originally thought, and you can reduce the amount of concentrate feed. On the other hand, you may find that the quality of the hay is poorer than you thought, and you may need to increase the amount of concentrate feed.

The figures in the following table illustrate one way of taking inventory of the forage supply on your farm.

**Factors for converting hays of varying quality into equivalent amounts of good hay**

Hay quality	Physical characteristics	Conversion factor
Excellent	Very early cut, leafy, bright green	1.2
Good	Early cut, leafy, green	1.0
Fair	Medium to late cut, without excessive damage or loss of leaves	0.8
Poor	Late cut, coarse, stemmy, unpalatable	0.6

Example: You have 60 tons of fair quality hay, 40 tons of good quality hay, and 20 tons of excellent quality hay. How many tons of hay do you have in equivalents of good quality hay?

$$60 \times 0.8 = 48$$

$$40 \times 1.0 = 40$$

$$20 \times 1.2 = 24$$

—  
Total = 112 tons in terms of potential feeding values instead of 120 tons

The 120 tons of hay you have represents only 112 tons of hay in terms of its potential feeding value. In actual feeding, animals will eat less of the fair quality hay when compared with good quality, therefore, the lower conversion factor. When fed excellent quality hay, animals may eat more of it. But even if they ate the same amount, the feed nutrients contained in the excellent quality hay will result in better animal production and performance than if the animal is fed lower quality hay.

### Summary

Hay quality generally means the same as feed value. Five basic factors are known to influence hay quality and animal performance, the most important of which is stage of maturity. Top quality hay is cut early, is leafy, has a bright green color, and is free from foreign material, mustiness, or mold.

The importance of developing skills in evaluating hay quality is not to win a judging contest, but rather to be a wise livestock feeder. Remember that the quality of the hay fed to your livestock determines how far you can cut down on the feeding of expensive concentrates and thus boost your profits. If you buy hay, your hay evaluation skills will be helpful in making wise buying decisions. If you can find both excellent and poor quality hays for the same price, knowing which is the higher quality feed can save you money.

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HOW TO USE A

# PLANT IDENTIFICATION KEY

LEADER GUIDE

Plants can be identified by means of keys based on plant characteristics, frequently the flower. Keys enable the user to distinguish one species of plant from another. However, a single key to all flowering plants would be so cumbersome it would be impractical to use. Thus plant manuals ordinarily contain keys for identification of only those plants found in a given area along with detailed descriptions of the plants. Select a manual covering the particular region where a plant is found.

## The key and its use

Keys present the user with questions about the plant. Each answer eliminates plants other than your specimen until the only choice left is the name of your plant. You make a series of "either-or" choices. A plant belongs in either the first or second choice. After this decision is made, you make another "either-or" choice. The process continues until the last choice brings you to the name of the plant.

The choices are guided by paired numbers. *It is important in every case to read both choices before deciding.* If you make the wrong

decision, further choices will often end in a blind alley or with some other plant which has characters obviously not like your specimen. In such cases, start over.

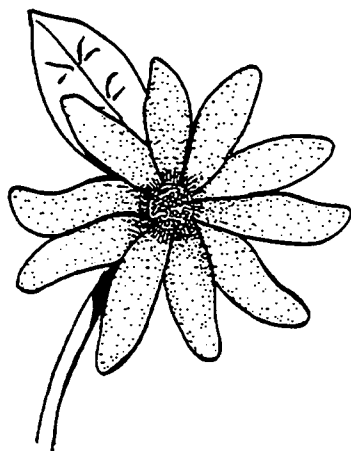
In a few cases, a given species of plant may fit into two contrasting parts of the key. Where this is most likely to happen, the key has been designed to guide you to the correct name by putting the plant in both parts. If you have difficulty deciding whether a plant does or does not have some characteristic, you may have to look at several plants before deciding.

Many people identify plants by their common name only; however, plants also have scientific names. For example, the scientific name for corn is *Zea mays*, the scientific name for alfalfa is *Medicago sativa*, and the scientific name for tall fescue is *Festuca arundinacea*.

The scientific name is the same wherever the plant is located. Common names often vary from one country to another and even between areas of the same country. The plant we call corn (*Zea mays*) is known as maize in Britain. Corn in Britain refers to wheat or other small grains such as barley. What is commonly



# HOW TO USE A PLANT IDENTIFICATION KEY



referred to as lotus in Oregon is known as birdsfoot trefoil (*Lotus corniculatus*) in most other parts of the U.S. The use of common parts alone can lead to serious misunderstandings.

By common consent of the botanists of the world, Latin has been accepted as the language for scientific plant names. Since it is not a spoken language it does not change, and it is understood by all scientific workers.

The scientific name of any plant consists of two words. The first or "genus" name is always capitalized. The second or "species" name is written with a lower case initial letter. The genus name corresponds roughly to our last name and the species to our first name, as *Zea mays* would be Brown, John. The scientific name may be followed by the abbreviation of the name of the person who first named the species. *Zea mays* L. means what this species was named by the great Swedish botanist Linnaeus.

## Example of an indented key

- 1a. Leaves parallel-veined ..... GRAMINEAE
- 1b. Leaves pinnately- or palmately-veined
  - 2a. Stamens, more than 10 ..... ROSACEAE
  - 2b. Stamens, 10 or fewer
    - 3a. Ovary superior
      - 4a. Petals not all of the same size and shape ..... LEGUMINOSAE
      - 4b. Petals all of the same size and shape ..... CARYOPHYLLACEAE
    - 3b. Ovary inferior
      - 5a. Flowers in umbels; anthers not united ..... UMBELLIFERAE
      - 5b. Flowers in heads, surrounded by a cluster of bracts; anthers united ..... COMPOSITAE

## Example of a bracketed key




- (1) Leaves parallel-veined ..... GRAMINEAE
- (1) Leaves pinnately- or palmately-veined ..... (2)
- (2) Stamens, more than 10 ..... ROSACEAE
- (2) Stamens, 10 or fewer ..... (3)
- (3) Ovary superior ..... (4)
- (3) Ovary inferior ..... (5)
- (4) Petals not all the same size and shape ..... LEGUMINOSAE
- (4) Petals all the same size and shape ..... CARYOPHYLLACEAE
- (5) Flowers in umbels; anthers not united ..... UMBELLIFERAE
- (5) Flowers in heads, surrounded by a cluster of bracts; anthers united ..... COMPOSITAE

The species is regarded as a group of closely related individuals, such as brothers and sisters. Species that are different but related by descent are grouped together in a genus. We might think of this as the cousin relationship. Just as related species are grouped into genera, so related genera are grouped into families, such as relatives are grouped in a family tree. This grouping continues through several more steps but is beyond our purpose.

The first step in identifying a plant is to determine the major group or family to which it belongs. Do this by using a key to families. When the plant is keyed to a family, read the description of that family to determine if the plant fits the description.

If the family description corresponds with your plant, continue with your key to a particular plant name. Turn to the illustrations or descriptive material for comparison when you have made a tentative identification.

**Key to legume foliage identification**

- 1a. Four or more leaflets
  - 2a. Five leaflets, tendrils absent
    - 3a. Not hairy on leaflets and petiole, pointed leaflets ..... Birdsfood trefoil  
(*Lotus pedunculatus*)
    - 3b. Hairy on leaflets and petiole, blunt leaflets ..... Big trefoil  
(*Lotus uliginosus*)
  - 2b. More than five leaflets, tendrils present
    - 4a. Broad leaflets, tip square (  ) or notched (  ); stems and leaves relatively smooth (not hairy) ..... COMMON VETCH  
(*Vicia sativa*)
    - 4b. Narrow leaflets, tip rounded (  ); stems and leaves of some plants may be hairy ..... HAIRY VETCH  
(*Vicia villosa*)
- 1b. Three leaflets
  - 5a. Pubescence on petiole
    - 6a. Stipules rounded at tip, no water mark on leaflets ..... Crimson clover  
(*Trifolium incarnatum*)
    - 6b. Stipules tapering or narrowing to a fine point
      - 7a. Stipules with purplish veins, most plants with water mark on egg-shaped leaflets ..... Red clover  
(*Trifolium pratense*)
      - 7b. Stipules not purplish veined, no water mark on heart-shaped leaflet ..... Sub clover  
(*Trifolium subterraneum*)
  - 5b. No pubescence on petiole
    - 8a. Creeping stems
      - 9a. Stipules membranous, completely clasping the stem ..... White clover  
(*Trifolium repens*)
      - 9b. Stipules large, erect, tapering evenly to a point ..... Strawberry clover  
(*Trifolium fragiferum*)
    - 8b. Erect stems
      - 10a. Width of leaflet more than half the length, margin serrate throughout ..... Alsike clover  
(*Trifolium hybridum*)
      - 10b. Width of leaflet less than half the length.
        - 11a. Two-thirds or more of the leaflet margin serrate ..... Sweetclover species  
(*Melilotus species*)
        - 11b. Outer one-half or one-third of the leaflet margin serrate ..... Alfalfa  
(*Medicago sativa*)

Keep these points in mind when using a key:

- Read both choices given, for although the first choice may seem good, the second may be better.
- Be sure you understand the terms; consult a glossary rather than guess at a meaning.
- Use a hand lens or microscope to be certain of the exact structure of any small characters mentioned.
- When measurements are required, make them accurately.
- Once you have arrived at a name in the key, read the description carefully to be certain that the unknown plant corresponds with the description.

The most acceptable type of key is probably the *dichotomous key*, since it gives only two choices at each point. It is much easier to use than one having several choices. There are two principal types of dichotomous keys, *indented* and *bracketed*. The following are examples of each type.

**Using simple cereal and legume keys**

Two simple indented keys follow. They illustrate the use of a key. The first is based on the foliage characteristics of the most common cultivated legume crops. The second is based on the foliage characteristics of the cereal crops. To use the keys you must understand the technical terms found in 4-H 1006, *Plant Identification Illustrated Glossary*.

# HOW TO USE A PLANT IDENTIFICATION KEY

Certain guidelines must be followed. First, you must realize that these keys are designed for identifying cultivated plant species grown in Oregon. Therefore the keys are limited to use on cultivated cereal and legume crops. Do not attempt to use these keys to identify uncultivated or wild species found along roadsides or in your yard.

A second guideline relates to the stage of plant maturity at the time of identification. With the legume key, only the foliage characteristics are necessary. For the cereals, the final separation between wheat and the two barley types requires that the heads be emerged.

These two simple keys are designed to show you how to use plant identification keys. They are considerably shortened in length and use a minimum of technical terms, so you can concentrate on the principles involved in the use of keys, while becoming more familiar with the plant species concerned. We suggest that you key each species several times before continuing, and become familiar with the characteristics used in the keys.

## References

The cereal and legume keys in this publication are limited to only the

### Key to cereal identification

- 1a. Leaves 25.4 mm (1 inch) or more in width; with a tassel at end of main stalk ..... CORN  
(*Zea mays*)
- 1b. Leaves less than 25.4 mm wide; no tassel at end of stalk
  - 2a. Auricles absent; spikelets in an open arrangement (stalked) ..... OATS  
(*Avena sativa*)
  - 2b. Auricles present; spikelets sessile (not stalked) and closely compact
    - 3a. Auricles hairy (pubescent); one spikelet per spike joint ..... WHEAT  
(*Triticum species*)
    - 3b. Auricles not clasping; one spikelet per spike joint ..... RYE  
(*Secale cereale*)
    - 3c. Auricles clasping; three spikelets per spike joint ..... BARLEY  
(*Hordeum species*)
      - 5a. Six distinct longitudinal rows of kernels on spike; three fertile florets per spike joint ..... SIX-ROWED BARLEY  
(*Hordeum vulgare*)
      - 5b. Two distinct longitudinal rows of kernels on spike; one fertile floret per spike joint ..... TWO-ROWED BARLEY  
(*Hordeum distichum*)

most common plants. Other publications are available. If you cannot identify your plant specimen from these keys, or if you are interested in more advanced identification keys, the following manuals will be of value:

- Gilkey, Helen M. and La Rea D. Johnston. 1975. *Handbook of Northwestern Plants*. Oregon State University Book Stores, Inc., Corvallis, Oregon.
- Hitchcock, C. Leo and Arthur Cronquist. 1973. *Flora of the Pacific Northwest*. University of Washington Press, Seattle, Washington.
- Peck, Morton E. 1961. *A Manual of the Higher Plants of Oregon*, 2nd ed. Binford and Mort, Portland, Oregon.

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