

HARVEST MANAGEMENT

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Harvest management is the primary method by which growers can influence the nutritional quality of alfalfa hay, and it has profound effects on forage yield and stand life. Deciding when to cut alfalfa is a difficult management decision because the grower must make trade-offs among yield, quality, and stand persistence.

ALFALFA GROWTH AND ROOT RESERVES

To understand the effects of time of cutting, it is helpful to review some principles of plant growth and alfalfa development. Plants utilize energy from the sun, through the process of photosynthesis, to transform carbon dioxide from the air and water from the soil into carbohydrates (Figure 11.1).

As a perennial plant, alfalfa stores some of the carbohydrates in its crown and roots. These stored carbohydrates are commonly called root reserves. They provide the energy for survival through winter, growth in the spring, and regrowth after cutting. During these periods an alfalfa plant pulls carbohydrates from roots until new leaves can photosynthesize carbohydrates sufficient to exceed the needs of the growing plant. After cutting, this takes about 2 to 3 weeks, or until the alfalfa attains a height of 6 to 8 inches. From this



point the plant begins replenishing root reserves (Figure 11.2). Carbohydrate reserves in roots and crowns increase with plant maturity until full flowering of the alfalfa. Cutting alfalfa at excessively immature growth stages—which occurs when cutting intervals are very short—does not allow enough time for the alfalfa to replenish root reserves. Vigor of new growth is affected. Stand life may also be reduced if alfalfa is repeatedly cut before root reserves are restored.

THE EFFECTS OF TIME OF CUTTING

Alfalfa yields per cutting increase as plants mature and the interval between cuttings increases. Yield increases

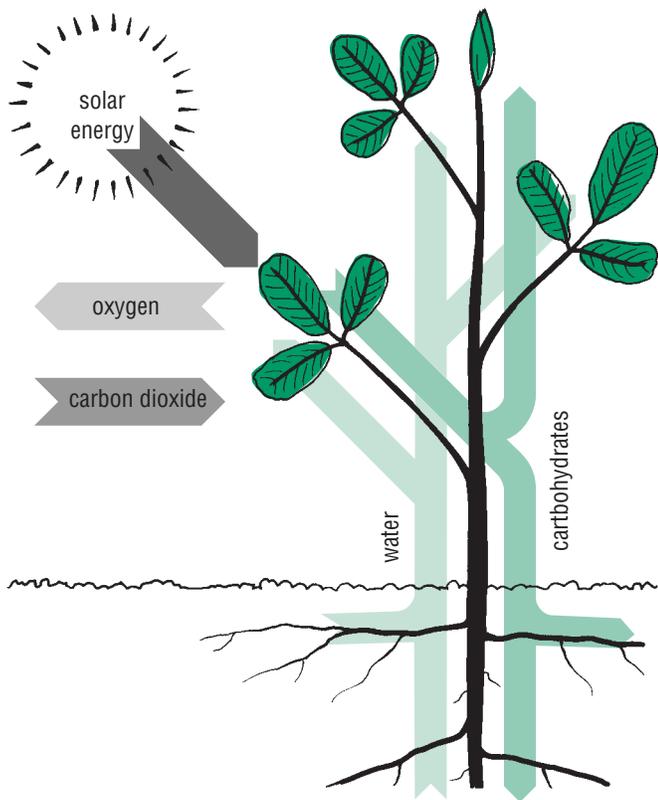


Figure 11.1. Through the process of photosynthesis, plants utilize energy from the sun to transform carbon dioxide and water into carbohydrates. Carbohydrates are used for new growth or are stored in the root for future growth and development. When stored in the root, carbohydrates are called root reserves.

approximately 120 pounds per acre per day in the Intermountain Region. In theory, the grower should obtain maximum yield when alfalfa reaches full bloom (Figure 11.3). Due to leaf aging (senescence) and loss from lower portions of mature alfalfa plants, however, the highest yields are sometimes obtained at around 50-percent bloom.

In contrast to yield, forage quality declines with advancing alfalfa maturity (Figure 11.4). Two reasons explain this decline. The first involves the proportion of stem weight. During the vegetative stages of alfalfa growth, the weight of leaves exceeds that of stems. However, as alfalfa matures beyond the early flowering stage, the weight of stems surpasses that of leaves as stems become longer and larger (Table 11.1). Therefore, much of the yield increase after bud stage can be attributed to increased stem weight, not increased leaf weight. Since leaves contain more nutrients than do stems, forage quality declines. The second reason why quality declines with maturity is that the fiber content of the stem increases as it matures.

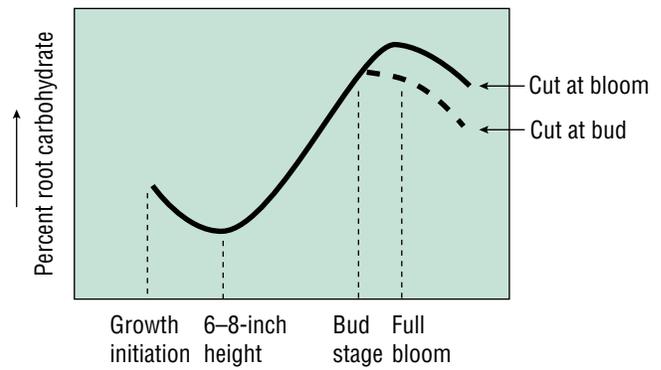


Figure 11.2. Cutting and growth stage affect the carbohydrate content of alfalfa roots.

In the Intermountain Region, as alfalfa matures from prebud to full bloom, total digestible nutrients (TDN) of a first cutting decline about 1 percentage point for every 4-day delay in harvest (that is, a decline of 0.25 percentage points per day). The amount of crude protein decreases approximately 1 percentage point every 5 days.

As mentioned, selecting the proper cutting time involves a compromise between top quality and maximum yield. Longer cutting intervals (that allow the crop to mature up to 50-percent bloom) generally result in higher tonnage and longer stand life but lower-quality hay. Conversely, very high-quality hay but short stand life and lower tonnage usually result from shorter cutting intervals (cutting alfalfa in the early-bud or prebud stage). In the Intermountain Region, it takes 3 to 4 weeks to restore root reserves and another 7 to 10 days to add surplus carbohydrates to the roots so the plant is ready for another cutting. Thus, under optimum conditions, the minimum

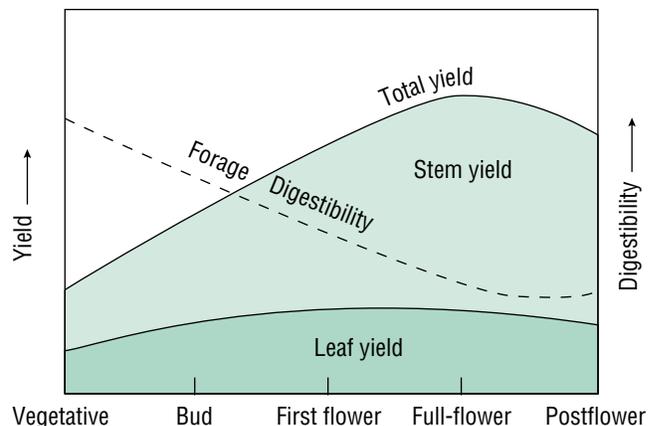


Figure 11.3. Forage yield relative to quality at different alfalfa growth stages.

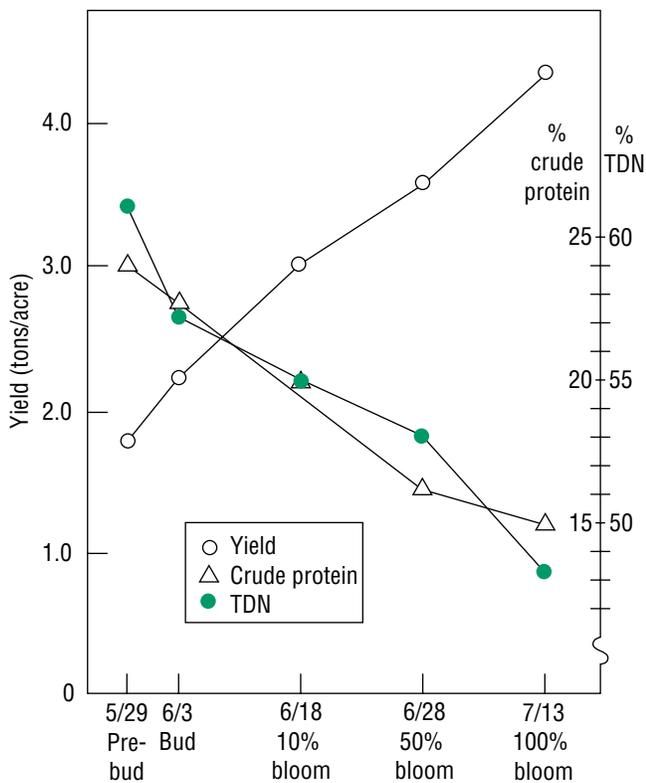


Figure 11.4. Yield and quality trade-off. As the date of first cutting is delayed, yield increases dramatically but total digestible nutrients (TDN) and crude protein decrease. (Data were gathered at McArthur, Shasta County, 1966–69.)

Table 11.1. Relative proportions of leaves and stems of alfalfa at three growth stages.

GROWTH STAGE	PERCENTAGE OF	
	LEAVES	STEMS
Bud stage	63	37
1/10 bloom	48	52
1/2 bloom	46	54

Source: Meyer and Jones (1962)

interval between first and second cuttings, or second and third cuttings, is 30 to 50 days. The time depends on weather and alfalfa variety. Regardless of variety, alfalfa will be weakened before the end of the first growing season if cut at intervals of less than 30 days. Too-frequent cutting results in reduced vigor and, often, weed infestation (because root reserves are depleted, alfalfa plants are less able to compete with unwanted vegetation).

In addition to time of harvest, seasonal changes in temperature and photoperiod (day length) impact for-

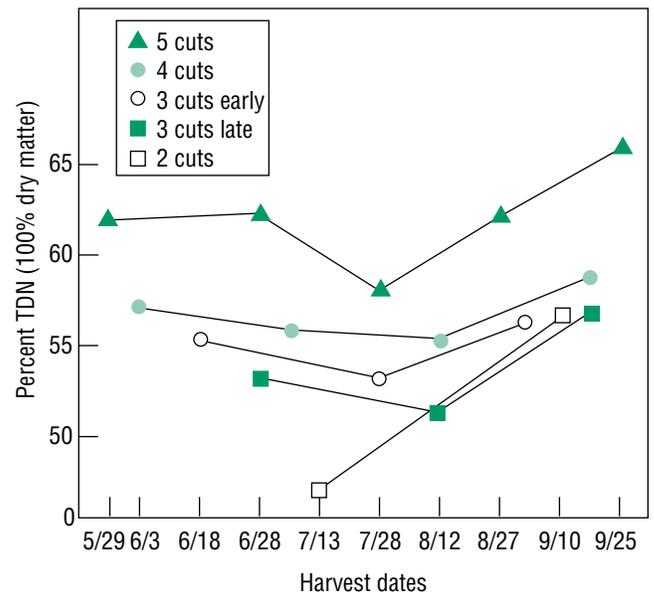
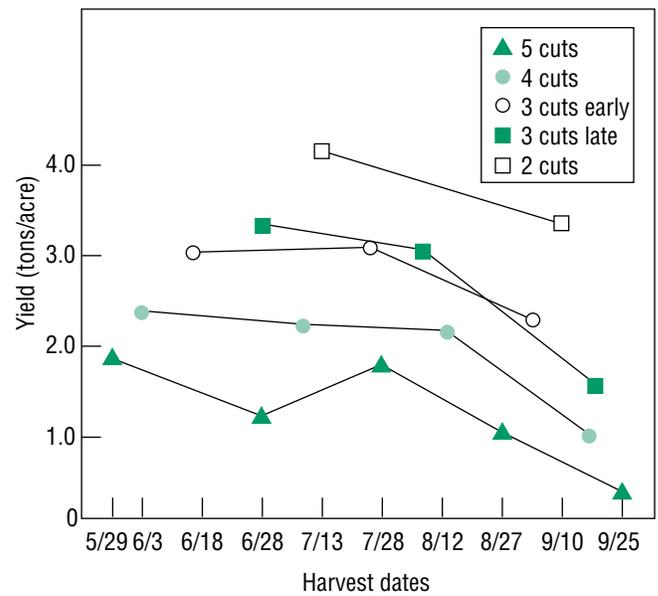


Figure 11.5. Seasonal variation in yield and TDN as they relate to cutting frequency at McArthur, Shasta County, 1966–69.

age yields and quality. In general, first-cutting forage yields tend to be higher than those of subsequent cuttings, regardless of the total number of cuttings per season (Figure 11.5). However, when the first cutting is taken at a very early growth stage (early-bud or sooner), second-cutting yields may be higher. The final cutting of the season, in the fall, yields less than previous cuttings because the alfalfa growth rate has slowed in response to cooler nighttime temperatures and shorter day lengths. In contrast to yield, the nutritional quality of the fall cutting is typically the highest

of the season. Alfalfa harvested in the spring and fall has higher TDN than alfalfa cut at the same growth stage in midsummer. Therefore, to achieve dairy-quality hay, alfalfa must be cut at a less mature stage in midsummer than in spring or fall. The yield sacrifice associated with such early cutting may be significant, encouraging many growers to delay harvest and produce beef or horse hay in midsummer.

SELECTION OF A CUTTING SCHEDULE

There is no optimum cutting schedule for all growers in all locations in the Intermountain Region. Several factors should influence the selection of a cutting schedule. These include the quality of the hay desired, weather conditions, the anticipated length of the growing season, harvest costs, desired stand life, and the alfalfa market.

The purpose of producing high-quality alfalfa hay is to take greatest advantage of the plant's nutrient potential as a livestock feed. Therefore, hay intended for use as a maintenance feed for beef cows or for "hobby" horses can be of much lower quality than that sold to dairies or used to grow weaner calves or yearlings. Hence, the growth stage at which alfalfa is cut should reflect the intended use for the hay. The dairy industry is demanding higher and higher quality. At one time premium hay had 54 percent TDN; the dairy market is now insisting on 55 or even 56 percent TDN (90% dry matter basis). Hay intended for this market must be cut early (late-bud stage at the latest) for the necessary quality to be achieved. Conversely, hay intended for beef cattle or horses can be cut later, at 10- to 30-percent bloom, to maximize yields with acceptable quality for these classes of livestock.

Alfalfa fields are sometimes harvested on a calendar basis, using a fixed interval and a fixed number of cuttings per season. The advantage of this method is that the number of cuttings per season is predetermined. This facilitates planning—it allows advance scheduling of irrigation, the cutting of other fields, and other activities. The problem with this method is that it does not account for weather or dormancy differences among alfalfa cultivars. Weather, primarily temperature, has a significant effect on alfalfa development and will cause plant maturity on a given date to vary

from year to year. The dormancy of a variety also influences its development. In general, a less dormant variety matures more rapidly than a dormant variety. Also, plants from different dormancy classes respond differently to temperature and photoperiod. Dormant varieties are more responsive to photoperiod than are less dormant varieties.

Another method of scheduling alfalfa harvests uses the growth stage of alfalfa to indicate the appropriate time to cut and the number of cuttings per season. The grower selects a specific alfalfa growth stage (such as bud, late-bud, 10-percent bloom, etc.) at which harvest will begin. This method takes into account the effects of environmental and varietal differences and results in more consistent, predictable forage yield and quality than when harvesting on a calendar basis. In some areas, the alfalfa growth stage at harvest is based on the appearance of bud or bloom; in others, regrowth from crown buds is used to indicate the proper time to cut. The regrowth method is less reliable with the dormant cultivars produced in the Intermountain Region. The primary drawback to cutting based on stage of development is that the number of cuttings per season is not defined—a partial cutting may remain at the end of the season. Unless grazing or green chopping is an option, there is little a grower can do when 0.50 to 0.75 ton of forage per acre remains in the field at the end of the growing season.

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The relatively short growing season in the Intermountain Region restricts the harvest schedule. Therefore, consider both calendar date and stage of growth when deciding on a harvest strategy. Modify harvest timing to fit three or four cuttings into the season. Four cuttings are often appropriate in the lower-elevation valleys and where dairy-quality alfalfa is

desired for all cuttings. However, the harvest costs imposed by a fourth cutting must be weighed against any price premiums that may be received for this top-quality alfalfa. A three-cut schedule is usually preferred when at least one cutting is used for beef cattle or horses.

Base the timing of the first cutting on the growth stage of the alfalfa. Cut alfalfa at the growth stage that will most likely result in the quality and yield desired. For example, cut at early-bud stage for a 1.5 to 2.5 ton per acre yield of dairy-quality hay, but cut at early-bloom stage for a 2.5 to 3.5 ton per acre yield of hay suitable for nonlactating dairy cows or beef cattle. If the date of the first harvest is very early or very late, regardless of the stage of development of the alfalfa, the calendar date will impact the timing of other cuttings; the total number of cuttings per season may then need to be adjusted. Likewise, consider the growth stage of the alfalfa and the calendar date when adjusting the date of cutting to accommodate variation in weather.

In valleys over 4,800 feet in elevation, the choice is normally between two and three cuttings. Research has shown that producers obtain equal yields by making three cuttings instead of two. However, by making three cuttings, they greatly improve forage quality and marketability.

CUTTING HEIGHT

Leave a stubble height of 3 to 4 inches when cutting alfalfa. Studies from the central and northern United States have shown that average annual yields of dry matter, protein, and digestible dry matter decrease as cutting height increases from 3 to 9 inches. Maximum yields were obtained at the 3-inch cutting height. Raising the cutting height did increase forage quality, but it caused a significant decrease in production that more than offset the slight increase in quality.

FALL HARVEST MANAGEMENT

The decision about when to begin the final alfalfa harvest of the season deserves considerable attention. Although weather conditions and their suitability for

making hay are important, they are not the only criteria. Keep in mind the effect of fall harvest management on stand life and vigor. Fall harvest management can also influence winter weed infestation, especially infestation by downy brome (cheatgrass) or hare barley (foxtail).

As mentioned, stored carbohydrates provide the energy for regrowth after cutting and initial regrowth

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in spring. You must allow the alfalfa sufficient time to replenish root reserves before cutting it. In addition to spring regrowth, root reserves are needed for winter hardiness. Insufficient root reserves going into the winter can result in reduced vigor, stand loss, and lower yields the following spring. Therefore, the last harvest of the growing season should occur 4 to 6 weeks before the first killing frost. (A killing frost is generally believed to be 25° to 26°F, or -4° to -3°C.) Cutting after a killing frost does not deplete root reserves. Consequently, a late harvest or grazing can be made during late October or early November if field conditions permit and growth is sufficient for a profitable crop. Unfortunately, curing conditions are seldom favorable at this time, so grazing or silage is usually the only option.

Predicting when a killing frost is likely to occur can be difficult. A grower can only rely on experience and historical weather data to time final cuttings. When a grower has numerous fields, cutting them all at the optimum time may be impossible. Fields cut too close to the first killing frost (mid-September to mid-October) should be allowed to grow to a late stage of development before the first cutting is made the following spring. The consequence of not doing so is reduced subsequent yields.

Most alfalfa growers in the Intermountain Region

have few alternative cash crops and want alfalfa stands to produce for 6 to 8 years or longer. For these growers, fall harvest management is critical. However, if profitable rotation crops are available and a stand life of only 3 to 4 years is desired, fall harvest management is much less important.

ADDITIONAL READING

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