Agronomy Facts 7

Cutting Management of Alfalfa, Red Clover, and Birdsfoot Trefoil

The goal of most forage programs is to maximize economic yield of nutrients while ensuring stand persistence. Frequent cutting produces high-quality forage, while less frequent cutting generally results in increased stand longevity. Therefore, harvest management of perennial legumes such as alfalfa, red clover, and birdsfoot trefoil requires a compromise between quality and persistence. The intensity at which these forage legumes are harvested should depend on the nutrient needs of the livestock that will be consuming the forage (Figure 1), as well as the life expectancy of the stand. Because of sudden changes in weather and year-to-year variation in growing seasons, there is no simple rule to follow when making a decision to cut.

PLANT FACTORS AFFECTING CUTTING MANAGEMENT

Decisions on when to cut have to be made based on a sound understanding of how a plant grows and survives.

Forage Quality

The stage of maturity at which forages are cut influences the feeding quality of that forage. Most forage crops decline in nutritive value as they mature (Table 1). A short delay in harvest can result in forage of much lower quality. However, early cutting to improve quality often reduces yield. In addition, continuous early harvests can reduce stand longevity. If forage stands are to be kept for only a couple years, forages may be harvested for higher quality than if long-lived stands are desired.

Energy Reserves

The initial growth of perennial forage legumes in the spring and after every harvest depends on energy reserves (food) stored in the taproots and crowns of the plants. High energy reserves are important for fast regrowth, which results in higher yields. Substantial energy reserves are also needed for the development of cold hardiness, which allows the plant to persist during the winter and still have enough energy for good spring growth. Research has shown energy reserves are usually highest when the plant is in the full-bloom stage and usually lowest a short time after cutting, when the plant is growing rapidly (Figure 2).

INDICATORS ON WHICH TO BASE CUTTING TIME

The stage of plant development is generally a reliable predictor of energy reserve status and when the plants should be harvested. However, when the weather is extremely cool and cloudy for an extended period and flowering is delayed,

Figure 1. Matching relative feed value (RFV) to animal needs.

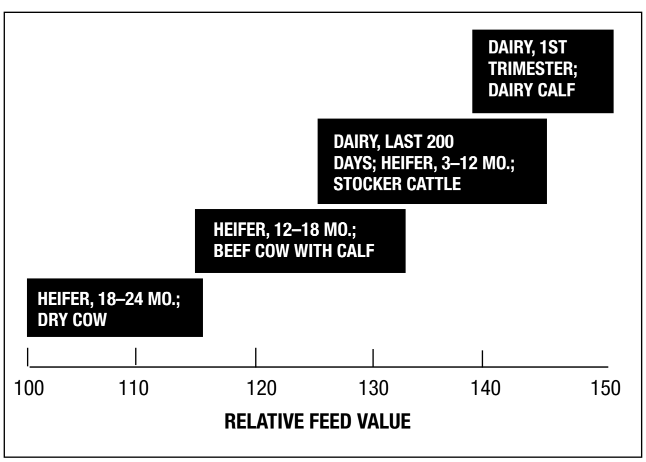


Table 1. Relationship of alfalfa maturity at harvest to crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and relative feed value (RFV), expressed on a dry matter basis.

	CP	ADF	NDF	
MATURITY	%	%	%	RFV[a]
Late vegetative	23	28	38	164
Bud	20	29	40	154
1⁄10 bloom	18	31	42	144
½ bloom	17	35	46	125
Full bloom	15	37	50	112
Seed pod	13	42	56	93

[a] RFV = (%DDM x DMI)/1.29 where %DDM (digestible dry matter) = 88.9 - (%ADF x 0.779) and DMI (dry matter intake) = 120/ %NDF.

Figure 2. Changes that occur in dry matter yields and root energy reserves during growth periods of an alfalfa crop. Stage I is early crop growth, Stage II is the crop at 6 to 8 inches tall , and Stage III is the crop when mature.

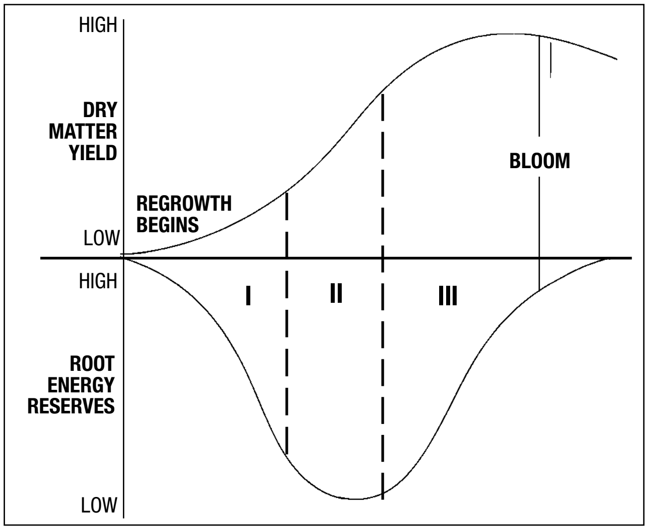
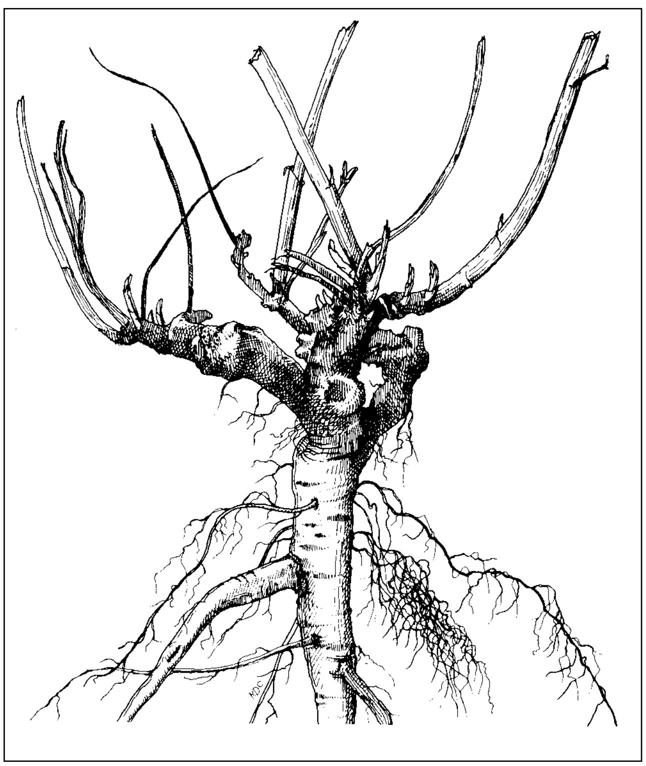


Figure 3. An alfalfa crown with new crown shoots.



Relying on the calendar alone to make a decision to harvest is unwise. Light, temperature, and moisture vary from year to year and have a direct effect on maturation. The most consistent method to determine when to harvest is the stage of plant development in conjunction with calendar date because seasonal weather variations can alter the relationship between stage of development and energy reserve.

DESCRIPTIONS OF LEGUME DEVELOPMENT STAGES

It is important to use terms such as half-bloom or mid-bud stage accurately since recommendations are often based on stages of maturity. The description of a stage of maturity refers to the whole field, not to individual plants. The most accurate method to determine the stage of development is to count 100 stems randomly selected from the field, and to determine the average stage of development as defined in Table 2.

ALFALFA CUTTING MANAGEMENT

Alfalfa is the most important forage legume in Pennsylvania. It is a deep-rooted legume that grows best in moderate to well-drained soils. Under optimum growing and soil conditions, and with proper management, yields can exceed 7 to 8 tons of hay equivalent per acre. In addition, disease-resistant varieties of alfalfa can be maintained 4 to 5 years, sometimes longer, depending on cutting management.

Seeding and Establishment Year

During the year of establishment, seedlings need a high level of energy reserves in order to persist through the winter. For spring seedings made without a companion crop, two harvests can generally be made the first year, provided the crop has adequate rainfall and optimum levels of soil nutrients. The first harvest can be made before flowers energy reserves continue to increase. Under these conditions, which often occur in May, the development of new shoots from the crown indicates that it is time to cut (Figure 3). A harvesting delay after the new crown shoots begin to grow can delay regrowth and reduce yield of the next harvest. Under normal growing conditions, particularly during summer, the development of new crown shoots may not occur until well after full bloom or even after seed set. Therefore, relying on the appearance of crown shoots to begin harvesting is not always advisable.

Table 2. Definition of stages in legume development.

TERMINOLOGY	DEFINITION[a]
Late vegetative	No visible buds, flowers, or seed pods. Stems at least 12 inches tall.
BUD STAGE	
Early bud	Visible flowerbuds on at least one stem (1%).
Mid-bud	50% of the stems have at least one bud.
Late bud	75% of the stems have at least one bud, no visible flowers.
BLOOM (FLOWER) STAGE	
First bloom	Flowers on at least one stem (1%).
Early or 1⁄10 bloom	10% of the stems have at least one flower.
Mid- or ½ bloom	50% of the stems have at least one flower.
Full bloom	75% of the stems have at least one flower, no visible seed pods.
Seed pod stage	Green seed pods are visible.

[a] Randomly select 100 stems from a field and determine the percentage of stems at the most mature stage of development.

begin to appear, but waiting for the alfalfa to flower will ensure greater energy reserves in the roots. Alfalfa will generally reach this stage of development between 60 and 70 days after emergence. The second harvest should either be made before September 1, to ensure an adequate buildup of energy reserves for winter, or be delayed until after the first killing frost (24°F) in the fall or after mid-October. Occasionally, when the second harvest is made before September and there are good fall growing conditions, a third harvest may be made after a definite killing frost. When mid-October or later harvests are made, a high stubble (6 inches) should be left for ground cover to protect the crowns and to catch snow for added insulation.

Spring seedings made with a companion crop such as oats are usually harvested for the first time based on the maturity of the companion crop. Alfalfa harvests made after the companion crop has been harvested should follow the same guidelines as for alfalfa seeded without a companion crop.

The spring harvest of a fall-seeded alfalfa crop should be based on plant development and vigor. If the alfalfa plants look vigorous and the roots are well developed, spring cuttings can be made at bud to early bloom stages. If plants are small and poorly developed, it is best to wait until mid-bloom stage before harvesting.

Established Stands

The intensity of cutting management (the number of cuttings made per year) should be based on the desired quality and life expectancy of the crop. If the goal is to have a long-lived stand, then a long cutting interval should be considered. If the crop is being grown under a short rotation (three years or less), then more cuttings may be desirable to maximize forage quality.

The first cutting in the spring can be made when the crop is in the bud to early bloom stage. There is generally limited environmental stress during the spring and the alfalfa crop can normally tolerate early cutting. Harvesting at the bud stage has allowed producers to get more cuttings per year, increase their production, and improve the quality of their forage. However, in order to cut this early, producers should have optimum levels of soil pH, phosphorus, and potassium, and plants should be allowed to reach the first-bloom stage at least once during the year.

Cuttings made during the summer (second, third, and fourth cuttings) should be made when the crop is in the bud to early bloom stage of development. Some producers are attempting to cut when the alfalfa is even less mature than recommended. A cutting interval that is consistently shorter than 30 days can be extremely stressful to the stand because energy reserves cannot be stored in the taproots and crowns. Low energy reserves lead not only to poor regrowth (which results in poor yields) but also an actual loss of stand—sometimes in one year.

Alfalfa, unlike red clover or birdsfoot trefoil, generally maintains production during short periods of dry weather because of its deep and extensive root system. However, during extended periods of dry weather, alfalfa growth is reduced and flowering may occur on short, stunted plants. Cutting during these stressful periods does not weaken alfalfa plants or cause stand reductions. If feed is badly needed, these stands of drought-stressed alfalfa can be controlled grazed. If adequate late summer or fall growth occur after the alfalfa plants have been drought stressed, an additional harvest can be made in the fall with less risk of stand loss than if the alfalfa was not drought stressed.

Fall Cutting Management

During the late summer and early fall, alfalfa plants are preparing for winter by developing cold resistance and storing energy reserves in their roots. Depending on the timing, fall harvest may interfere with this process. Harvesting alfalfa at a time that allows only a few weeks of regrowth before the herbage is killed by frost greatly reduces energy reserves in the roots. Late harvesting also removes stubble, which catches snow and insulates plants from extremely cold air temperatures. Both situations increase the risk of alfalfa winter-kill.

Winter environmental conditions can aggravate the effects of fall harvesting. Temperatures of 5°F will injure alfalfa crowns and roots. Soil and snow serve as insulation between the alfalfa plant and cold air temperatures. Lack of snow increases the risk of winter-kill. Wet soils freeze and thaw more intensively, which increase the amount of frost heaving. Don't fall harvest fields that have a history of frost heaving or of accumulating little snow cover.

Risks to stand persistence can be minimized by:

1. Taking at least one harvest during the summer at 1⁄10 bloom or greater.
2. Fall harvesting young stands because young stands are less susceptible than old stands to winter injury.
3. Maintaining high soil fertility levels.
4. Fall harvesting alfalfa varieties that have good disease resistance and winter hardiness.

Although fall harvesting increases the risk to stand loss (compared with not fall harvesting), the need for forage or the value of the forage may be greater than the risk. Making the decision to cut in the late summer or fall requires weighing the risk of winter injury against the need for the forage. Use the scoring system in Table 3 to assess the risk of late summer or fall harvesting alfalfa.

Optimum levels of potassium in the soil enhance the storage of energy reserves in alfalfa roots. Maintaining high reserves of energy in the roots as winter begins does improve the ability of alfalfa to overwinter and support good spring growth. It is important that adequate potassium be available during the late summer and early fall because the storage of energy reserves for winter survival occurs during this time. Applying potassium fertilizer after the plants go dormant for the winter does not benefit energy reserve storage.

Table 3. Calculating risk of alfalfa winter injury due to late summer or fall cutting. Enter the score for answers that describe your management.

POINTS		SCORE
1. What is your stand age?		
>3 yrs	4	
2–3 yrs	2	
<1 yr	1	
2. Describe your alfalfa variety: a. What is the fall dormancy (FD) score?		
Moderately dormant (FD ≥ 4	3	
Dormant (FD = 3)	2	
Very dormant (FD ≤ 2)	1	
b. What is the disease resistance?		
Moderate resistance to only bacterial wilt	4	
Moderate resistance to bacterial wilt plus either Phytophthora root rot, Fusarium wilt, or anthracnose	3	
Moderate resistance to all above-mentioned diseases	1	
Alfalfa variety total score (multiply a x b)		
3. What is your soil K_2O level?		
Low (<210 lb/A)	4	
Optimum (210–340 lb/A)	3	
High (>340 lb/A)	1	
4. What is your soil drainage?		
Somewhat poorly drained	4	
Moderately well drained	3	
Well drained	1	
5. Describe your harvest frequency:		
Four cuts by Sept. 15	4	
Four cuts by Oct. 15	5	
Four cuts by Sept. 15 with an additional cut after killing frost	5	
Four cuts by Sept. 1 with an additional cut after killing frost	4	
Three cuts by Sept. 1	1	
Three cuts by Sept. 15	2	
Three cuts by Sept. 1 with an additional cut after killing frost	2	
Three cuts by Sept. 15 with an additional cut after killing frost	3	
6. On mid-September or October cuts, do you leave ≥ 6-inch stubble?		
No	1	
Yes	0	
Determine your total score (The sum of points from questions 1 through 6)		

For fall cutting risk:

If your score is:	Your risk of winter injury is:
5–8	low/below average
9–13	moderate/average
14–18	high/above average
19 or more points	very high/dangerous

Adapted from C.C. Sheaffer, University of Minnesota, 1990.

RED CLOVER CUTTING MANAGEMENT

When well managed and properly fertilized, newer varieties of red clover can potentially yield 4 to 5 tons of good quality forage. Red clover generally establishes quickly and can grow on soils too wet or too acid for alfalfa. However, red clover, normally lasts only 2 to 3 years. The highest yields usually are obtained in the second year of production.

Proper cutting management can help improve yields and persistence of red clover.

Seeding and Establishment Year

It is important to harvest red clover before full-bloom stage during the establishment year. Red clover allowed to reach full-bloom stage often has reduced stands and yields the following year. Apparently, crown tillers that develop into floral stems during the first summer deplete energy reserves and reduce the ability of the plants to survive the winter.

Red clover that is spring seeded without a companion crop can usually be harvested twice in the year of establishment, provided that weeds are controlled. Some producers are taking three cuts during the year of establishment, but this requires high soil fertility and favorable weather conditions. The first cutting should be made before mid-bloom. A second removal can usually be made sometime in early August. If a third cut is taken, it should be done by mid-September.

Red clover that is seeded with a companion crop can usually be harvested only once during the establishment year, between mid-August and mid-September.

Established Stand

The first harvest of red clover should be made when the field is at early bloom. Later cuttings can be made at late bud or early bloom stage. During hot and dry weather, red clover growth slows and flowering may occur on short, stunted plants. Cutting during these stressful periods can weaken red clover plants and cause stand reductions. If feed is badly needed, these stands can be lightly grazed. If there is good fall growth, an additional harvest can be made in the fall

BIRDSFOOT TREFOIL CUTTING MANAGEMENT

Birdsfoot trefoil is a deep-rooted legume that grows well on poorly drained soils. A properly managed crop can persist for many years. Cutting management of birdsfoot trefoil is different from that of alfalfa because energy reserves of trefoil remain relatively low during the growing season, regardless of the number of harvests. Therefore, a cutting height of no less than 3 inches is recommended so that enough leaves remain on the plants to provide energy for regrowth.

Seeding and Establishment Year

Birdsfoot trefoil seedling growth is slower than growth of either alfalfa or red clover. In addition, trefoil is not competitive during stand establishment. Harvests in the first year should be delayed until the trefoil is in full bloom. For seedings made without a companion crop, one harvest can usually be made during the seeding year.

Established Stand

Since birdsfoot trefoil has relatively low energy reserves during the growing season, it is important not to harvest until trefoil has begun to bloom. The first cutting can be made at early bloom, and later cuttings should be delayed until at least mid-bloom stage (about 6-week intervals). In the fall, 4 to 5 weeks of growth should be allowed before the first average killing frost date. To ensure a thick stand, trefoil can be allowed to reseed itself every 2 or 3 years. The forage quality of trefoil at this stage of maturity is adequate for livestock that have moderate to low nutrient requirements.

LEGUME-GRASS MIXTURE CUTTING MANAGEMENT

To optimize forage yield and quality, cutting management of a legume-grass mixture should be based on the harvest schedule of the legume. However, the planned legume cutting management influences what grass species should be grown. If the legume crop is under intense cutting (four or more cuttings per year), species such as orchardgrass, perennial ryegrass, and reed canarygrass are compatible because they tolerate frequent cutting. A less intensive system (three cuttings per year or fewer) is compatible with timothy or smooth bromegrass, which require longer intervals between cuttings and generally do not tolerate early spring harvest.

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