



GRAZING ALFALFA

*Economic and Sustainable
Use of a High-Value Crop*

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Introduction

Alfalfa has long been recognized as the premier forage crop around the world. Though grazing alfalfa is not a common practice in most of the United States, it is widely practiced in other regions, and certainly feasible in the United States.

The common perception is that alfalfa is only grown for hay and silage, and grazing should only occur for clean-up of hay fields. Many would say that it is too valuable to be regularly used as pasture, or that the cost and effort of establishing alfalfa makes it impractical to use as a pasture crop.

The demand for high-yielding, high-quality pastures is increasing due to the expense of mechanical harvesting, consumer interest in grass-fed products, and concern regarding animal welfare. Grazing is a key component of organic production systems, and grazed alfalfa is an important opportunity. Alfalfa provides the ideal pasture crop because it combines high yields, high quality, nitrogen (N) fixation, and environmental benefits.

Grazing alfalfa is a common practice in Argentina, Australia, and other countries around the world. Grazing

alfalfa and alfalfa/grass mixtures is an important component of the meat and milk production systems in Argentina, where nearly 7.9 million acres of alfalfa are grown for pasture.

Grazing alfalfa requires a higher level of management than other grazing systems. In spite of this, interest in grazing alfalfa in the United States has been increasing. As Kansas State University Extension livestock specialist Larry Corah stated, "The only thing wrong with grazing alfalfa is that not enough people do it."

This publication will review the important considerations of alfalfa grazing for meat and milk production, its role in sustainable systems, and highlight how alfalfa can be used for grazing by all livestock including sheep, goats, and horses. It will also provide a realistic overview of the benefits and challenges of grazing alfalfa and assist producers in determining if grazing alfalfa fits for their livestock operations. Grazing alfalfa should be considered a useful component in pasture systems and not simply a residue management practice in hayfields or a rescue harvest when haymaking is impractical.

Benefits & Challenges of Grazed Alfalfa

Benefits/advantages

- Lower cost
- High livestock production per acre
- Improved animal health
- Animal welfare
- Lower fertilizer requirements
- Consumer preference in some markets
- Environmental benefits
- Inexpensive weed management
- Farm sustainability

Challenges/disadvantages

- Variable yield and quality over season
- Soil compaction, crown damage
- Bloat risk
- Increased management requirements
- Lower per animal production than confined feeding
- Weed encroachment
- Difficulty balancing rations

Increased Interest in Grazing Alfalfa

There are numerous reasons for the increased interest in grazing alfalfa in the United States.

1. Appreciation of alfalfa – This is particularly true in Southern and transition zone states, where alfalfa has often been a “forgotten crop.” Market value for grass-fed beef, increased on-farm backgrounding, organic dairies, and recent success with interseeding alfalfa with various grasses have all generated interest in alfalfa.

2. Emphasis on forage quality – Producers have become much more focused on forage quality in pasture systems in recent years, and alfalfa has always been recognized as a crop having the highest forage quality resulting in excellent animal health and production.

3. Acceptance of management-intensive grazing – Grazing alfalfa requires a higher level of grazing management than many forages. The widespread acceptance and use of temporary electric fencing and watering systems makes intensive rotational grazing available to all producers, large and small. The attendance at grazing schools around the country show producers are willing to invest the time and effort required for management-intensive grazing systems.

4. Combination hay/grazing systems – Producers are finding alfalfa is not only an excellent crop for hay and silage, but it also fits well into grazing programs. When adverse weather makes alfalfa difficult to cure, it can be utilized for grazing. In addition, mid- to late-summer hay cuttings can be uneconomical to harvest because of reduced growth. In mild climates, grazing alfalfa regrowth during winter periods has proved effective at improving animal health as well as controlling winter weeds and alfalfa weevils. Grazing provides an efficient way to utilize this growth and provides valuable pasture when cool-season grass and clover growth is limited.

5. Environmental benefits – Alfalfa fixes more atmospheric N/acre than any other crop. The N fixed by alfalfa goes directly into crop growth rather than becoming a problem through leaching or volatilization as can happen with high N fertilizer rates on many



Beef cow grazing high-quality alfalfa (Henning).



Temporary electric fence (Henning).



Combining hay harvest and grazing can expand utilization and profitability on individual fields (Gerals).

other grazed crops. Grazed alfalfa and alfalfa/grass fields also have reduced weed pressure, lower weevil control requirements, lower overall pesticide use, and lower fuel use.

6. Economic benefits – Free N fixed by alfalfa can reduce N requirements in pastures to zero (mixed stands may require some N). Alfalfa is a long-lived perennial crop which reduces energy and equipment requirements compared to annual forages. Forage harvesting costs have increased rapidly in recent years, but meat and milk prices have not kept pace. Even with the lower harvest efficiency of grazing vs. haying, the cost of harvesting alfalfa is greatly reduced when livestock consume it directly through grazing.



Typical grazing pattern as a beef cow enters a new alfalfa paddock (Henning).

7. Organic dairy certification requirements – USDA Organic Certification requires at least 30% of daily livestock intake of the milking herd be from pasture during the grazing season. The yield and quality of alfalfa allows higher stocking rates and higher milk production per acre than most pasture crops.

8. Most persistent legume – Alfalfa is one of the most persistent forage legumes. Therefore, producers can be assured of a high legume component in mixed grass stands without having to overseed every 2-3 years as is required for red and white clover in most parts of the country.

9. Drought and salinity tolerance – Although alfalfa is a cool-season forage, its deep root system and ability to thrive at high temperatures makes it one of the most drought-tolerant forage crops. This is not surprising since it originated in the Middle East. Furthermore, unlike drought-tolerant summer annual forages, alfalfa is a perennial with a long growing season, and maintains high quality throughout the season. Additionally, alfalfa can be grown on saline soils; data have shown it can tolerate salinity levels of over 6.0 dS/m after establishment. Interestingly, trials are underway in South Korea to grow alfalfa on reclaimed land produced from dredging the seafloor. In addition, Australians have grown alfalfa as a grazing crop on saline regions to lower shallow saline groundwater.

10. Reduced fossil fuel use – The need for fossil fuels is reduced by more than 90% when alfalfa is harvested by grazing in comparison to harvesting for stored feed. Typically, 3-4 field trips utilizing tractors are required per cutting (or 12-20 trips per year) to accomplish mechanical harvest – most of which is conserved with grazing systems.

11. Reduced carbon emissions – Grazing alfalfa, which often requires zero N fertilizer, can impact carbon budgets in several ways, including: 1) protein is produced biologically, not from nitrogen derived from fossil fuels; 2) stable deep-rooted alfalfa fields sequester carbon in the roots and in the soil microbial community; and 3) grazing greatly reduces need for tillage in agricultural landscapes, which further reduces carbon emissions.

12. Marketing opportunity – Grazing alfalfa can provide an important marketing edge in many regions by producing “pasture-fed” products (milk and meat). Allowing stockers, or cows and calves to graze hay fields during July and August provides excellent summer forage and allows producers to efficiently use alfalfa too short to economically cut for hay. Mid-summer alfalfa pasture is higher in forage quality than comparable cool-season grass pastures.

Adapting Grazing to Alfalfa Growth Patterns

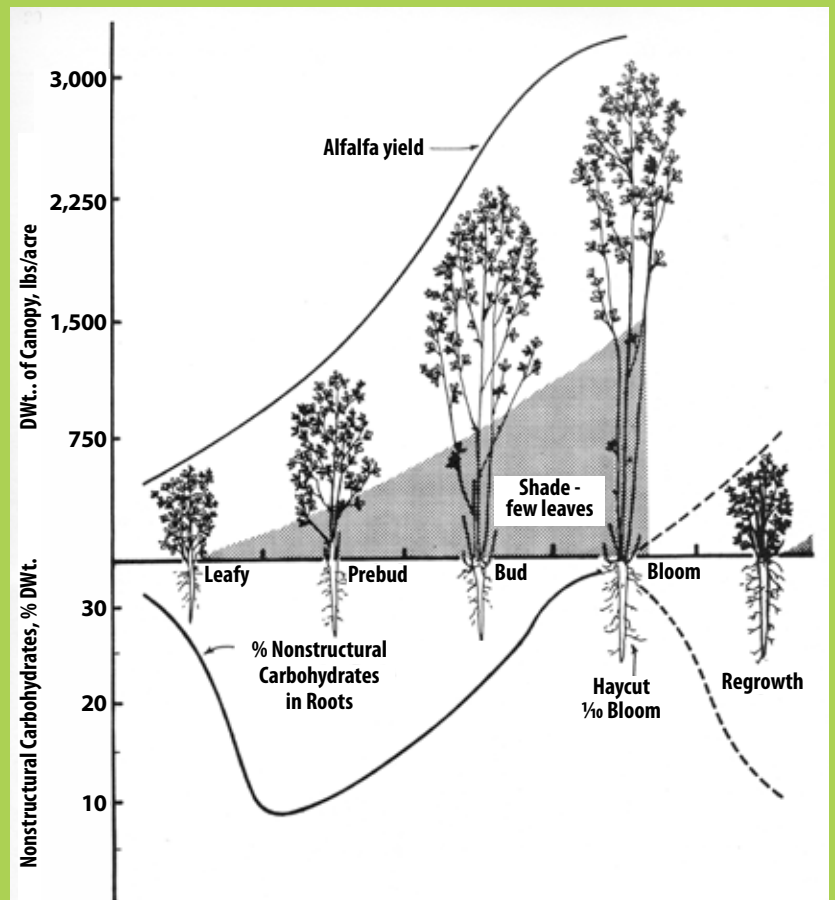
It is important to understand alfalfa's growth cycle and plant morphology to successfully graze alfalfa. New spring growth, as well as regrowth after cutting, comes from crown buds close to or just above the soil surface. As these new shoots grow, the tips of alfalfa stems produce auxin (a hormone suppressing new growth). When the mature stems are cut or grazed, auxin production ceases, crown buds are released from dormancy, and new growth begins. Crown buds appear as small shoots forming new stems that become the next crop.



Alfalfa crown buds are dormant at the base of the plant until after defoliation by grazing or cutting (Henning).

Partial defoliation (incomplete grazing) of alfalfa can be self-defeating. When only the top portion of the stem is removed, axillary buds on the lower portion of the stem start to elongate and grow. Not only are these axillary stems smaller, weaker and lower-yielding than stems arising from the crown, they suppress growth of new stems from the base of the plant. Because of the negative effects of partial defoliation, pure stands of alfalfa should be grazed as close to the ground as possible without damaging the crown. In mixed stands with grasses, grazing height should be determined based on the ideal height of the companion grass species. For example, mixed alfalfa/orchardgrass stands should be grazed to leave a 3-4" residual height, while mixed alfalfa/bermudagrass stands can be grazed to 1-2". If orchardgrass or similar tall-statured grasses begin to dominate, then closer grazing heights will encourage alfalfa growth and inhibit growth of the companion species.

In addition to residual height considerations, it is essential to allow a sufficient regrowth period between grazing harvest. Alfalfa has a large taproot which stores carbohydrates needed for rapid regrowth. After a grazing event, these carbohydrate reserves are used for rapid regrowth, but they typically drop by 50-70% and do not start to replenish until there is sufficient leaf area for photosynthesis. Therefore, an average of 30 days of regrowth is required to fully replenish alfalfa root carbohydrate reserves. Continuous grazing is not advisable, as it depletes root stores of carbohydrates and weakens the plant.



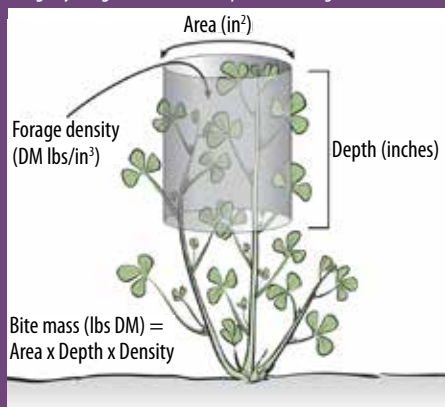
Classic image by Blaser (1986) showing the root carbohydrate cycle in alfalfa under hay harvest or grazing.

Forage Quality & Preference

The bottom portion of alfalfa stems are less palatable and less digestible than upper stems and livestock are reluctant to consume them. Therefore, for most operations, a two-phase grazing system is best. For the first grazing, use livestock classes with a high nutrient demand, such as stockers, lactating cows, and fattening lambs. For the second grazing, follow with animals having lower nutrient requirements, such as dry cows, wool sheep or goats. Dairy producers often graze high-producing cows first and later move low producers or dry cows through for a second or even third grazing.

Cattle do not graze quickly to the ground like mechanical harvesters, but graze in sections. During the first grazing, they consume about 50% of available forage by volume from the top of the canopy (Figures 1 and 2). In a second grazing, animals consume about 50% of remaining forage, and, though volume is greatly reduced, another 50% will be consumed in a third grazing event.

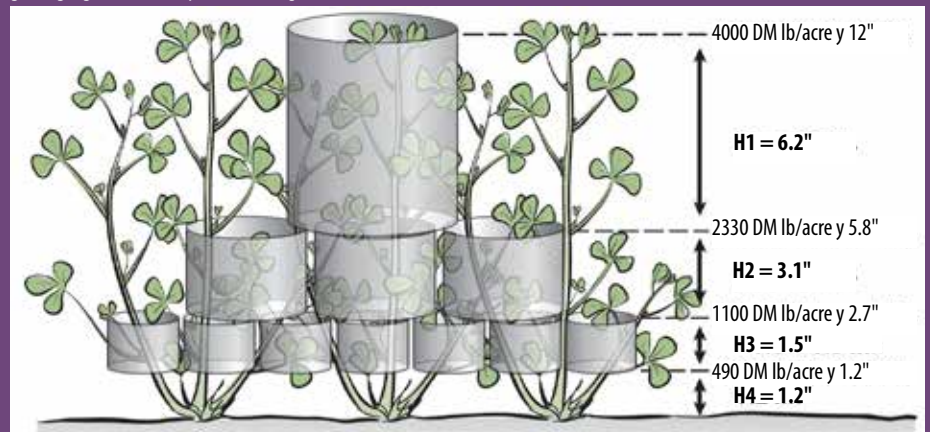
Figure 1. Bite dimensions and bite mass of grazing bovine. Generally, in a first grazing, animals consume 50% of available forage by weight or volume (adapted from Cangiano, 2002a).



Goat and sheep graze much the same way as cattle during a first grazing, but during a second grazing they often selectively graze only the leaves. If left intact, these defoliated stems can suppress the growth of new crown buds. Therefore, mowing or clipping after small ruminant grazing, and even cattle grazing, can stimulate more rapid regrowth. Horses tend to be more "spot" grazers, defoliating certain areas of a pasture to the ground before moving onto other areas. Therefore, rotational grazing of small areas at a time is essential.

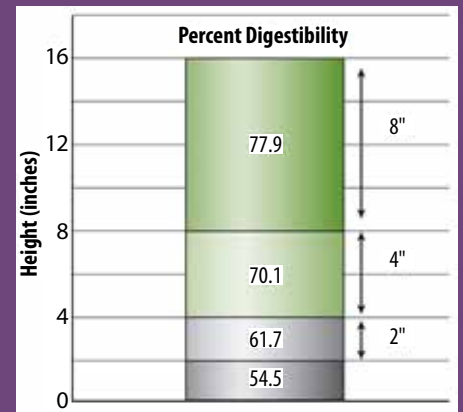
There are dramatic differences in forage quality as livestock graze an alfalfa canopy from top to bottom (Figure 3). The highest digestibility forage is in the top of the canopy and will be consumed during the first grazing. As discussed previously, animals with the highest nutrient demand should be allocated the first grazing of an alfalfa pasture since forage quality is reduced significantly from top to bottom. The leafy and tender shoots are at the top, and stemmy, more fibrous portions of the alfalfa plant are at the bottom. Animals tend to consume less as

Figure 2. After the first grazing, herds will graze another 50% of the available forage in the second grazing, and, in a third grazing, again 50% (adapted from Cangiano, 2002b).



they move down the canopy and the forage is progressively lower in quality. Understanding how animals graze and how plants regrow provides the basis for understanding and applying grazing management for alfalfa.

Figure 3. Digestibility of alfalfa pastures varies significantly by location in the canopy, with the highest quality at the top, lowest at the bottom (adapted from Cangiano and Galli, 1999).



Lower stems have lower forage quality compared to upper portion of the canopy (Henning)

Growing the Crop

The optimum way to grow and manage alfalfa for grazing is very similar to the ideal management practices for hay and silage. Excellent alfalfa management guidelines are available including the *Alfalfa Management Guide* (Undersander et al., 2011) and *Irrigated Alfalfa Management* (Summers and Putnam, 2008). The following is a brief description of important management considerations:

- Plant on a well-drained soil.
- Use a soil test as a guide for fertilizer applications such as lime, phosphorus (P), potassium (K) and boron (B). It is essential that pH is 6.5-7.5 for optimal production.
- Use certified seed of a climatically adapted, high-yielding, disease- and insect-resistant variety for your region. Some universities have special variety tests to determine the most grazing-tolerant varieties under actual pasture conditions. A good reference is NAFAs *Alfalfa Variety Ratings* publication.
- Most alfalfa seed is pre-inoculated with the correct strain of rhizobia bacteria to insure N fixation. Make sure to inoculate raw seed or when pre-inoculated seed is past the inoculum expiration date, and store seed under cool conditions.
- Control broadleaf and grassy weeds during establishment with recommended pre-emergent or post-emergence herbicides. Clipping stands for weed management during the first growing season may be essential, especially for organic producers. Grazing during the establishment period may be feasible to control weeds, but must be done carefully to prevent seedling injury. Using Roundup Ready® alfalfa allows for fairly simple yet comprehensive weed control. Producers may control problem weeds by beginning with pure stands of Roundup Ready® alfalfa and adding desired cool-season grasses at the end of the first or second growing season.
- Use all methods to assure a good stand. Sow into a firm seedbed with proper seeding depth at a time of year allowing for optimal germination. Plant no deeper than ¼" in heavy soil or ½" in light soil. Consult alfalfa management guides or state extension publication recommendations for information relevant to your region.



Alfalfa stands where weed issues have not been managed (Henning/Smith).

- Soil test on a yearly basis. Once soil fertility is at an optimal level, testing can be reduced to every other year with alfalfa and alfalfa/grass pastures since most nutrients are recycled through manure and urine when grazing. In certain regions of the country, regular tissue testing is important to determine if deficiencies exist for P, K, B, sulfur (S), and molybdenum (Mo).

Alfalfa Grazing Management

Alfalfa can be grazed throughout the growing season in most areas of the United States, or it can be managed for combination hay/pasture and only grazed during selected times of the growing season.

Season-Long Grazing – Grazing has a reputation for shortening the life of an alfalfa stand compared to harvesting alfalfa for hay. However, this is only true when producers graze alfalfa pastures continuously or use long grazing periods. By following the recommendations outlined below and paying attention to the alfalfa growth patterns discussed earlier, producers can capture all the benefits of grazing alfalfa, without reducing stand life.

Ideally, alfalfa should be allowed a recovery or rest period of 28-35 days before re-grazing. Grazing periods of 3-5 days or less are recommended. Grazing periods can be increased to 5-7 days with more fall dormant (FD) varieties due to their slower regrowth rate (i.e., FD ratings 3 and 4). Long recovery periods are key to season-long grazing and maintenance of productive stands. In addition, avoid grazing during wet weather when alfalfa is particularly susceptible to soil compaction, crown damage, and trampling.

Spring Grazing – Alfalfa may be grazed early (coinciding with initial green-up) in areas of the country where the soil is firm in the spring. By grazing alfalfa for several weeks in the very early spring, hay making can be delayed until drying conditions are better for hay curing. Additionally, alfalfa weevil damage can be reduced as livestock graze the stems where weevil eggs were laid the previous fall and where immature larvae are developing. With an early spring grazing strategy, perennial warm-season grasses can be protected so they are available to carry cattle later in the summer. This strategy may also be helpful for controlling leaf diseases by removing infected leaves and decreasing inoculum for future infections.

An alternative spring grazing strategy has been utilized in Virginia trials. In these studies, grazing began when alfalfa was over 4" high and grazing pressure was managed so the average plant height did not exceed 6-8", while leaving some leaf area on the plants. Grazing continued until the normal date of the first hay cutting when regrowth was allowed to resume for 40 days

before hay harvest. Using this spring grazing strategy, Virginia researchers recommend allowing the alfalfa to grow for at least one, and preferably two, hay cuttings before grazing again to allow full replenishment of root carbohydrates (White, 1991).

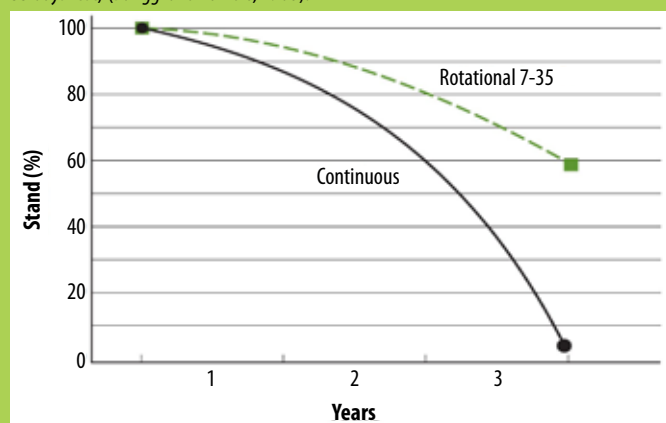
Summer Grazing – Alfalfa can be uneconomical to harvest for hay during July and August when top growth has been slowed by drought. In addition, long days, high light intensities, and warm temperatures hasten plant maturity and cause blooms to develop prematurely, lowering forage quality of hay harvests. Grazing alfalfa at this time will provide high-quality forage compared to cool-season grasses which are going through their "summer slump" period.

Fall Grazing – Fall alfalfa growth is usually slowed or stopped by a series of light frosts and cold weather, rather than by one single heavy killing freeze. Forage quality of this fall growth is frequently excellent. Weather conditions normally make alfalfa hay difficult to cure at this time, so grazing can be a very beneficial method of harvesting. Early to late-fall grazing is common across thousands of acres of hay fields in many western states from California and Arizona to Montana, Wyoming, and the Dakotas. Where the alfalfa weevil is an issue, removing this fall growth may also reduce weevil damage the following spring.

It is important not to overgraze fall growth. While stubble height is not of great significance during the summer, it becomes an important factor for late-fall grazing. In the northern regions, leaving some stubble on the field, 3-4", will hold snow for insulation and form a thatch to protect alfalfa from heaving. Grazing too closely will damage crown buds and have a serious impact on production the following year. Late-fall grazing should be limited if fields are soft or waterlogged, since significant crown damage and soil compaction can occur and hinder water infiltration and spring regrowth. In areas with extended periods of below-freezing temperatures, early fall grazing should stop with enough time to allow 4-6 weeks of rest to replenish root reserves before winter. Grazing to remove residual growth can then resume after a killing freeze.

Some universities have variety tests to determine the most grazing tolerant varieties. Most of these tests use continuous grazing to provide a worst-case scenario and to shorten the time required to show grazing tolerance. Under actual farm conditions, continuous grazing is never recommended and alfalfa does not have to be a grazing-tolerant variety to be grazed if recommended grazing management practices are used. Alfalfa stands can rapidly decline when continuously grazed (Figure 4). Some stand decline can occur even with rotational grazing, but increases in crown size can compensate for any potential loss of plants per unit area in well-managed stands. It should be noted that wheel traffic during hay and silage harvest also significantly damages alfalfa fields, and grazing is frequently less damaging than wheel traffic.

Figure 4. Alfalfa stand percentage, as a function of the initial number of plants, is affected more by continuous grazing compared with rotational grazing (7 days grazing followed by 35 days rest) (Bariggi and Romero, 1986).



Determining the number of paddocks or pasture subdivisions necessary is a function of the length of time it takes to graze a paddock and the length of the rest period for that subdivision. Table 1 provides a guideline for the number of paddocks required based on days grazed and days rested for a 40-day grazing cycle.

Table 1. An example of the relationship between the number of subdivisions (paddocks) required and grazing and resting days for a grazing cycle of 40 days. The goal when grazing alfalfa is a grazing period of one week or less and a rest period of 28 or more days.

Grazing period (days)	6.7	5	4	3.3	2.9	2.5
Resting period (days)	33.3	35	36	36.7	37.1	37.5
Number of subdivisions (paddocks) required	6	8	10	12	14	16

Reducing Potential for Bloat

Bloat is probably the greatest worry in managing alfalfa pastures. Bloat can be a problem when cattle are grazing young, lush alfalfa but the risk can be greatly reduced and mitigated with several management techniques. Bloat results when leafy soluble proteins are consumed rapidly, forming a stable froth or foam in the rumen which does not allow gases released by rumen microbes to escape. The rumen becomes distended or stretched and compresses the lung cavity, making breathing difficult. In severe cases, this compression may cause death from suffocation.

There is less danger of bloat in grazing alfalfa when the foliage is dry or the crop is in the late bloom stage. Although it is important to be aware of the potential for bloat, it can be prevented through management practices listed below and by feeding bloat preventative products (such as poloxalene).

Bloat is not a new concern when grazing legumes like alfalfa. In 1716 Mortimer wrote about grazing legume-grass mixtures in *The Whole Art of Husbandry*. He emphasized care was needed when cattle were first put into it, "... lest it burst them." He further added, "This could be prevented by not letting them have too much, and by supplying straw; but the best way was to turn them into it the first day about noon, when the dew is off, and in a dry day, for about half an hour; the next day for an hour; ... then till four or five o'clock in the afternoon, and after that there will be no danger." Current recommendations are quite similar to those written 300 years ago!

Recommended Steps to Manage Bloat – When cattle graze lush alfalfa, no management practices can guarantee bloat will not occur, but the following management strategies will greatly reduce the incidence of bloat:

- Observe cattle carefully at least twice a day when they are first turned onto alfalfa pastures. Observe again following any abrupt change in the weather.
- Graze grass-alfalfa mixtures instead of pure alfalfa, especially when livestock are first adapting to grazing alfalfa.
- Use caution when grazing immature alfalfa. Research shows that cattle introduced into an alfalfa stand less than 10" tall had two times higher potential to bloat

than when the stand was 19" tall. Some producers even wait until an alfalfa pasture is at bloom stage before introducing cattle for the first time.

- Limit grazing during wet, cloudy periods in the early spring when alfalfa is making its most rapid growth. Extra caution should be taken at this time.
- Put animals on lush alfalfa pastures only when plants are free of surface moisture (dew or rain).
- Provide a full feeding of quality grass hay before turning animals into lush alfalfa stands for the first time. High-quality hay will be consumed readily by livestock and provide rumen fill, thereby preventing “gorging” on the alfalfa. Animals tend to avoid low-quality hay which reduces rumen fill.
- Although bloat is associated with certain forages, some animals have a genetic predisposition to bloat; consider culling chronic bloaters.
- Do not necessarily remove animals immediately from alfalfa pastures during the first signs of bloat (Figure 5A), but watch them closely. A consistent pasture diet results in less incidence of bloat than removal and return. It can take a week or more of grazing alfalfa for the rumen microbes to adapt to the high levels of soluble proteins in high-quality alfalfa pastures.
- Provide good access to water and minerals. Healthy animals and healthy rumens adapt faster to high-legume diets.
- Mowing and wilting an alfalfa pasture prior to grazing has shown some potential to reduce the incidence of bloat, based on research in the Upper Midwest.
- Feed bloat-reducing compounds like poloxalene. Feeding poloxalene either in blocks, lick tanks, or mixed

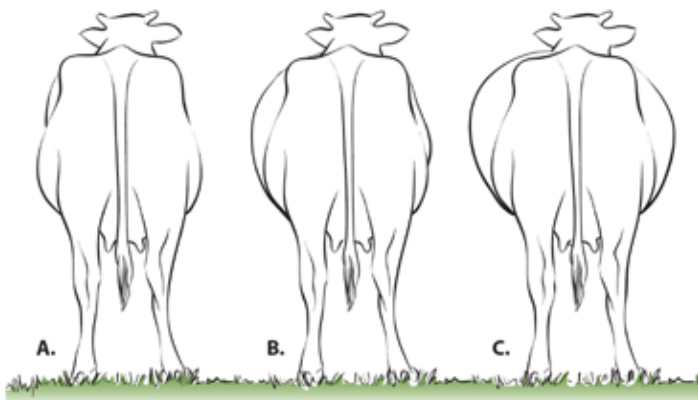
with grain or other ground feed provides good insurance against bloat. This compound has the effect of lowering the surface tension of frothy bubbles, allowing release of rumen gasses. Bloat blocks provide the easiest method to administer poloxalene, but intake is difficult to regulate. Many producers favor feeding poloxalene with grain to allow more consistent intake.

Begin feeding poloxalene two to five days ahead of turning cattle onto alfalfa pasture. Use higher dosages when cattle are first placed on alfalfa pasture, and reduce the rate if no problems occur. Cattle on lush alfalfa will require more poloxalene than those on more mature alfalfa. Always, follow the manufacturers’ recommendations when using poloxalene and other bloat preventatives. Research has also indicated the rumen modifier monensin has reduced bloat in cattle grazing alfalfa.

If one considers the number of cattle grazing alfalfa and other legumes worldwide, the “fear of bloat” results in far greater economic losses from low beef cattle gain than the potential losses from bloat itself. Under well-managed alfalfa grazing systems, bloat losses can be reduced to less than 1%.

Plant breeders have long desired to develop alfalfa varieties that are “bloat safe.” Dr. Bernie Goplen in Canada made progress towards this goal with a long-term breeding program and released the “reduced bloat” variety “AC Grazeland Br” in 1997 (Coulman et al., 2000). In Argentina, National Institute of Agricultural Technology (INTA) scientists developed the “bloat-tolerant” non-dormant alfalfa variety “ProINTA Carmina” using Goplen’s techniques. Numerous trials were conducted on research stations and commercial farms (with large animal numbers) and ProINTA Carmina reduced the incidence of bloat an average of 23% (5% to 64% range) (Bernáldez, 2009). Due to several extenuating circumstances, neither of these varieties were widely adopted by cattle producers.

Figure 5. Degrees of bloat can be estimated visually: A) mild, B) moderate, C) severe.



Beef cattle grazing mature alfalfa to reduce bloat potential in Argentina (Basigalup).

Management-Intensive Rotational Grazing

Management-intensive rotational grazing is essential for optimum returns in an alfalfa grazing system. Rotational grazing is more labor-intensive than continuous grazing because of the need to provide and maintain fencing and to move livestock from one paddock to another on a carefully planned and executed schedule. Care must also be taken to avoid damaging the alfalfa stand, because comparatively high numbers of cattle graze on a relatively small area. However, the rewards of higher animal production easily offset the extra effort.

There is no set rule on the number of paddocks required or on paddock size when grazing alfalfa. Ideally, paddocks should be sized or stocked such that the desired defoliation is completed in 3-5 days. Paddock size depends on the number and weight of cattle being grazed. Most recommendations call for fields to be divided into a minimum of 6-8 paddocks for the most effective grazing management.

As an example of paddock numbers, a small demonstration in Kentucky successfully grazed 24 cattle on a 4-acre alfalfa pasture. The field was subdivided into eight half-acre paddocks with temporary fencing, making the stock density 48 head/acre in a single paddock at the same time. After 4-day grazing periods, the cattle were rotated to different paddocks. After eight paddocks had been grazed four days each, cattle were returned to the first paddock, which had 28 days to recover. This system allowed for a short grazing period (4 days) and a sufficiently long rest period (28 days) so that alfalfa in the initial paddock was ready for a second grazing. Such a system requires portable water tanks or an alley system to a central water tank.

It is a good idea to have a handling facility or temporary pen using gates located strategically to provide easy access from the paddocks. Use this as a place to feed and water the animals and to medicate them if needed. This "catch" pen is also a good place to provide poloxalene and to hold cattle when paddocks are too wet to graze.

One or more "sacrifice" paddocks enhance a grazing program where alfalfa is the main forage. A sacrifice paddock is an area, preferably with grass sod, that can be used to hold cattle during wet weather or to allow adequate regrowth of the alfalfa paddocks before regrazing. Hay may be fed in sacrifice paddocks when animals need to be withheld from alfalfa pastures for an extended period.

Stocking Rates

Stocking rates can be difficult to determine and vary based on cattle size, climatic conditions, and time of year. One method to determine stocking rate (number of animals per acre that a system can carry) is to use the following simple formula. This and similar grazing formulas can be found in University of Kentucky extension publications "Rotational Grazing" (Smith et al., 2009) and "Using a Grazing Stick for Pasture Management" (Smith et al., 2010).

$$\text{Animals/acre} = \frac{\text{DM/acre} \times \% \text{ utilization}}{\text{Animal wt.} \times \% \text{DMI} \times \text{days per paddock}}$$

The formulas to determine ideal paddock size for a herd and the days of grazing per paddock are given below:

$$\text{Paddock size (acres)} = \frac{\text{Animal wt.} \times \% \text{DMI} \times \text{animal number} \times \text{days per paddock}}{\text{DM/acre} \times \% \text{ utilization}}$$

$$\text{Grazing days per paddock} = \frac{\text{DM/acre} \times \text{acres} \times \% \text{ utilization}}{\text{Animal wt.} \times \% \text{DMI} \times \text{animal number}}$$

The components of these formulas are: 1) Animal wt. – weight per head, in pounds; 2) %DMI – percent dry matter intake, ranging 2-4%; 3) animal number – number of head to be grazed; 4) days per paddock – amount of time animals are to be allowed to graze in a given paddock; 5) DM per acre – estimate of total forage dry matter available per acre before grazing; and 6) % utilization – portion of available forage per acre that animals will consume during a grazing period.

Percent utilization depends on stocking rate, days of grazing, avoidance around manure, damage from trampling and other factors. When grazing periods are short (1-3 days) and rest periods are 4-5 weeks, it is reasonable to expect 65-70% utilization rates when grazing alfalfa and alfalfa/grass mixtures. This utilization is lower than with mechanically harvested forage where everything is removed.

General recommendations suggest 3-5 stocker calves per acre as a conservative stocking rate for the early part of the grazing season. Stocking rates can be increased as alfalfa becomes more productive beyond the first year of stand life and as the management skills of the producer improve.

Stocking rates normally are reduced when alfalfa production declines, such as during the typical mid-summer growth slump. It is very important to closely monitor grazing to prevent overgrazing. As discussed earlier, overgrazing forces animals to consume lower stems, which have a lower nutritive value. More importantly, severe overgrazing can damage crowns of the alfalfa plants limiting regrowth and long-term stand persistence. This is particularly true with sheep since they have the ability to graze to ground level.

Undergrazing, on the other hand, can lead to uneven utilization. When unevenly grazed, the ungrazed plants become larger and less palatable. When the field is grazed again, animals will favor young tender plants. This selectivity effectively reduces the productive acreage available to be grazed unless the older, larger plants are clipped periodically.



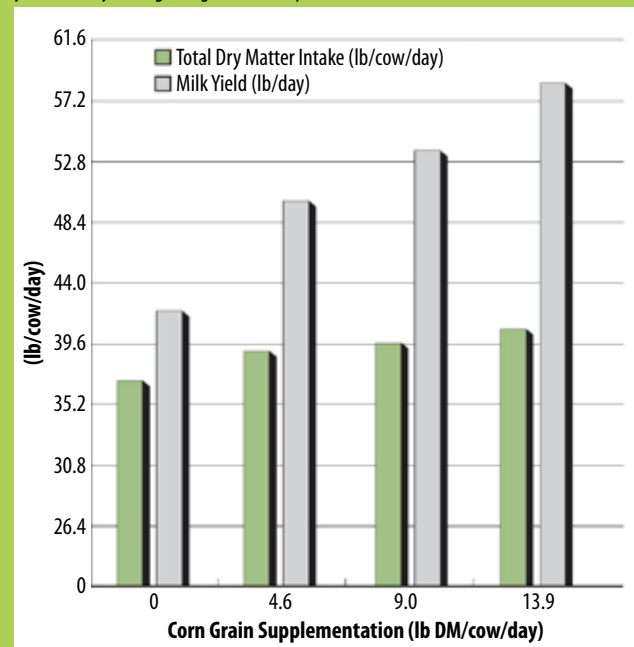
Undergrazing, or lack of complete consumption of alfalfa stems, wastes feed and can suppress subsequent growth (Thompson).

Maximizing Milk Production When Grazing Alfalfa

Although not common in the United States, grazing alfalfa for dairy production has many benefits and not just for dry cows and developing heifers. One of the primary benefits is lowering the cost of feed. Alfalfa pasture can meet nearly all the nutritional needs of a lactating dairy cow, when properly managed, with some supplementation and integrated within a total balanced ration. In smaller dairy operations in Argentina (<150-200 cows), it is common for alfalfa to be grown in pure stands for the dual purpose of hay production and grazing.

Research has shown minimal corn grain supplementation significantly boosted milk production for dairy cows grazing alfalfa (Figure 6). Corn provides the necessary energy to complement the high protein and high digestibility of alfalfa. The economic benefits of grazing organic dairy herds on alfalfa/grass mixtures with minimal grain supplementation was also highlighted in recent work from the University of

Figure 6. Effect of corn grain supplementation on total dry matter intake and milk yield of dairy cows grazing alfalfa (adapted from Castillo and Gallardo, 1995).



Kentucky and University of Tennessee (Allison et al., 2021). In this economic modeling study, an alfalfa/grass pasture (>75% of the ration) was much more profitable than several combinations of cool- and warm-season annual pastures.

An Argentina study divided a 110-acre farm into three units, or farmlets, to compare stocking rates when grazing alfalfa (Baudracco et al., 2011). Pastures on each farmlet contained alfalfa/grass mixtures (80% alfalfa) and were grazed (with daily moves) by crossbred Holstein-Jersey cows averaging 1,000-1,050 lbs/head. Over 65% of daily intake was grazed alfalfa, along with 6 lbs/day grain concentrate. The remainder was sorghum silage grown on each farmlet. Milk production was 49-52 lbs/day, but even more impressive was the production of 22,280-33,730 lbs/milk/acre/year (this included the acres planted for sorghum silage). This study showed a milk herd can consume a majority of their ration as high-quality alfalfa pasture and still maintain good milk production per cow and milk production per unit of land. There were also no health issues for any of the cattle grazing this high percentage of alfalfa.

Additional Argentina studies have shown the value of grazing alfalfa for dairy cattle, especially when milk prices are low and concentrate supplementation prices are high. One study researched the effect of the ionophore monensin when 1,300-lb Holstein cows consumed 36-42% of their diet as a alfalfa/grass pasture (Gallardo et al., 2005). Monensin has several production benefits for beef and dairy cattle, but a prime benefit when grazing alfalfa is bloat protection. Milk production was good with and without monensin (62 and 59 lbs/day, respectively), but the monensin treatment maintained better body condition score and increased pregnancy rate at first service.

A third study in Argentina examined grazing by Holstein cows (averaging 1,350 lbs/head) with three levels of daily alfalfa forage allowance (Danelon et al., 2015). Daily allowance was 30 lbs/DM/cow, 60 lbs/DM/cow, and 90 lbs/DM/cow, but the actual quantity of alfalfa consumed by each group was 26.6 lbs, 31.7 lbs, and 32.3 lbs, respectively. Each group was also fed 10 lbs of concentrate per day. The additional forage allowance resulted in greater selectivity (and consequently higher forage quality) and not a commensurate increase in

intake. The milk production for each group was similar at 53.5, 57.6, and 61.0 lbs/day, but the low forage allowance group was forced to consume lower-quality, stemmy forage near the ground. This group lost 0.77 lb/day over each 5-week grazing period, whereas the medium and high-forage allowance groups gained 0.2 and 0.51 lb/day. This study not only highlights the potential for high milk production potential when grazing alfalfa, but also the importance of providing high-producing animals with the highest-quality pasture. Therefore, with dairy cattle, it is essential to provide daily access to a new paddock (or section when strip grazing) to maximize forage quality and sustain milk production.

Although the milk production per cow from these studies may not sound impressive compared to the highest-producing cows in the United States, it is important to remember that the average dairy cow in the United States weighs 1,700 lbs and produces an average of 60 lbs/milk/day. The smaller cows in Argentina were producing similar amounts of milk per day while they were consuming the majority of their feed as alfalfa pasture at lower cost. The cost of feed in the Argentinian alfalfa grazing system was significantly lower than the cost of feed on the typical dairy in the United States.



Dairy cattle grazing high-quality alfalfa in Argentina (*Basigalup*).



Dairy cows grazing alfalfa in the southeastern United States during the summer slump period for cool-season grasses (*Henning*).

Beef Cattle Production on Alfalfa

A range of university studies and producer experiences have confirmed the potential profitability of grazing alfalfa with beef cattle. Profitability is determined by the amount of animal gain and the costs incurred to achieve it. Exact figures vary depending on establishment and input costs, crop growing conditions, stand health, operator management efficiency, initial animal weight and condition, animal price margins, and other factors influencing animal gain and profitability in alfalfa grazing operations.

An advantage of grazing alfalfa with beef cattle vs. dairy cows is the added flexibility in determining the grazing period. Beef cattle can better compensate for the “seesaw effect” of forage-quality fluctuations when using 3- to 7-day grazing periods. In other words, there is high quality in days 1 and 2 with declining quality every day after. On the last day, quality is usually low (very few leaves and too many lower stems). When animals are moved to a fresh paddock, the forage-quality cycle repeats.

The following examples provide an overview of recent beef cattle production studies grazing alfalfa or alfalfa/grass mixtures. Although applicable for any commercial beef producer, they may be most useful when considering the growing niche market for forage-fed beef (commonly referred to as grass-fed). Forage finishing steers on alfalfa or alfalfa/grass is a good option to meet the demand for this product.

A Virginia study looked at animal performance and carcass/meat characteristics of beef steers under grazed alfalfa vs. a corn silage/grain diet (Scaglia et al., 2012). The overall gain over two grazing seasons on alfalfa was 2.2 lbs/day. Beef produced on the alfalfa pasture diet (compared to concentrate) was leaner and had acceptable organoleptic characteristics. In addition, steers grazing alfalfa had greater backfat thickness and ribeye area compared to steers grazing endophyte-free tall fescue. Alfalfa-fed animals had higher yellow fat content, which some consumers may view as a detriment. The yellow color is due to the presence of carotenoids, which are antioxidants with the potential to protect against disease and enhance the immune system. Research has shown carotenoids to decrease risk of macular degeneration, cataracts, some cancers, and cardiovascular events.

Another Virginia study compared steers grazing alfalfa, endophyte-free tall fescue, and a mixture of the two (Boland and Scaglia, 2011). Interestingly, steers grazing pure alfalfa

gained 1.4 lbs/day, but those grazing the mixture gained 1.9 lbs/day. Many producers choose to graze alfalfa/grass mixtures not only to reduce bloat, but also for added stand durability and the carbohydrate-to-protein ratio of the grass component.

An Oklahoma three-year study with steers starting at 550 lbs showed average daily gains of 2.1-2.3 lbs/day (Butler et al., 2012). Researchers tried an interesting approach by using continuous grazing, but carefully monitored stocking rate with a put-and-take system to reduce overgrazing. Put-and-take simply means putting on more animals when forage availability is high and taking them off when availability is low. Gains were good using this approach, but stands showed considerable thinning after three years of grazing. Thinning likely occurred from a buildup of diseases or depletion of root carbohydrate reserves from the continuous grazing, or a combination of both. Rotational grazing is recommended when grazing alfalfa, even when using grazing-tolerant varieties.

A Utah study investigated combining a tannin-containing legume, birdsfoot trefoil, in a mixture when grazing alfalfa (Waldron et al., 2019). Tannin-containing legumes offer the benefit of reducing bloat incidence and improving rumen bypass protein. Although bloat was not measured, steers grazing the alfalfa-trefoil mixture gained 1.6 lbs/day. A companion alfalfa/tall fescue mixture produced 1.5 lbs/day, but alfalfa comprised only 30% of the mixture.

There is a common perception that high forage quality provided by alfalfa grazing is best suited for stocker operations. But an Iowa study showed impressive calf gains when cow/calf pairs grazed alfalfa and alfalfa-smooth brome grass mixtures (Hermann et al., 2002). Calf gains ranged 2.4-2.6 lbs/day with a 4- to 5-month grazing season. In addition, calves grazing the alfalfa-smooth brome grass mixture produced 18% higher gain per acre than smooth brome grass plus N fertilizer treatment. Cow body condition scores were generally maintained or slightly improved, especially during post-breeding.

In summary, average gains of 1.5-2 lbs/head/day are typical when cattle are grazed on pure alfalfa stands or in mixtures with grasses, and beef gains of more than 1,000 lbs/acre over the grazing season are possible.



Beef cows grazing alfalfa stand (Henning).

Alfalfa Grazing for Sheep, Goats, & Horses

Alfalfa can also be grazed by other livestock species including sheep, goats, and horses. The practice of bringing sheep or goats into dormant alfalfa hay fields in California and Arizona in the fall and winter, referred to as “sheeping off” or “goating off,” is a widely accepted practice (Long and Doran, 2013; Long and Putnam, 2019). The small ruminants consume the alfalfa vegetation that dies back in winter, producing cleaner hay the following spring. They also feed on winter weeds and help control weevils by feeding on older alfalfa stems, where the alfalfa weevil lay eggs. This practice has the potential to reduce leaf diseases



“Sheeping off” a California alfalfa hay field in late November. (Putnam).

the following growing season by reducing field inoculum load from the old plant material. Since most of California’s lambs are born in the fall and early winter, grazing alfalfa during this period accommodates the lambing operation by providing high-quality feed for lactating ewes and lambs at a time when forage is usually scarce. Hay fields are grazed using temporary electric fence to establish paddocks, and sheep are moved to new areas of the field daily or every few days. Sheep and goats are also ruminants, so it is important to practice the bloat prevention strategies discussed earlier.

Virginia studies have shown early alfalfa growth can be grazed by sheep with little or no effect on the second

hay crop (Chappell, 1986). Gains of 0.33 lb/day can be expected for 70-lb lambs grazing pure alfalfa. Concentrate supplements will further increase gains. Alfalfa is excellent for grazing ewes in late gestation when extra energy is needed during the last six weeks of pregnancy.

Horse owners have long used alfalfa and alfalfa/grass hay as a premium-quality feed. In fact, alfalfa was associated with horses and the military prowess of the Indo-European



Horses grazing alfalfa in Kentucky (Lacefield).

empires from at least 700 BC. The very word “alfalfa” has Arabic and Persian roots and connotes “best horse fodder.” Grazing alfalfa with horses is less common than with cattle, but has potential benefits. Oklahoma studies with yearling horses rotationally grazed on alfalfa showed gains of 1.3 lbs/day over a 37-day period and horses remained in a moderate body condition throughout the study. Many owners are concerned alfalfa’s high quality is “too rich,” but the yearlings in the Oklahoma study had no digestive disorders (Freeman et al., 1987). Minnesota research showed no difference in baseline, average, or peak blood glucose or insulin in horses grazing alfalfa, cool-season grasses, or teff (DeBoer et al., 2018). Several other common misperceptions about feeding alfalfa to horses are addressed in an excellent publication *Alfalfa – High-Quality Hay for Horses* (Lawrence et al., 2020).

Summary

Grazing alfalfa is a key component of sustainable agricultural systems, conferring a range of environmental and animal health benefits. Alfalfa can be successfully grazed by most livestock classes. Grazing has a number of advantages over mechanical harvests: 1) lower feed cost, 2) lower fuel requirements, 3) animal health and welfare, 4) ability to utilize crop growth otherwise unavailable, 5) utilization of high-quality forage, 6) high animal production per acre, and 7) environmental benefits due to biologically fixed N. It offers opportunities for economic forage utilization and niche marketing animal products as “forage-fed” or “grass-fed.” While grazing systems often show lower production per animal compared to confinement feeding, the production per unit area or per unit cost is often superior. Grazing alfalfa is best managed through careful rotational grazing methods, understanding crop growth characteristics, and utilizing supplementation to balance rations.

The major disadvantage to grazing is the inability to maximize yield and quality – suggesting integration of grazing with mechanical harvests might be best. Bloat is a risk but can be successfully managed, as evidenced by the millions of acres of alfalfa grazed worldwide. High-level grazing management of alfalfa can play a key role in the development of sustainable intensive forage systems in the future.

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Roadside photo of cattle grazing alfalfa in central Montana in August (Smith).

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