GRAZING ALFALFA

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Introduction - Alfalfa (Medicago sativa) is a native of an area south of the Black and Caspian seas and it still grows wild in Iran and eastern Anatolia. Alfalfa was the chosen forage for the fighting horses of ancient armies as long ago as 1800 B.C. when the Kassites conquered Babylon. The spread of alfalfa followed the pathway of armies through the Mediterranean, Europe, and the New World. For ages before man used alfalfa to fuel his fighting animals natural selection processes worked on the evolution of alfalfa and its predecessors. A scenario which would account for the morphology and physiology of alfalfa is as follows. Alfalfa evolved in a climate similar to that which it is best adapted. Under these conditions alfalfa would be subjected to periodic grazings as flocks or herds moved in migratory patterns. During stress periods plants which avoided drought or cold damage had an advantage and survived. Concurrently, possibly because of the low nitrogen status of the soils, symbiotic nitrogen fixation coevolved. This latter characteristic is often associated with plant colonizers. In more recent times the natural selection pressures were modified by man but the fact remains that evolution of alfalfa was primarily influenced by grazing herbivores, and was not affected by man until recently. Evidently the selection pressures under grazing were consistent with our modern management of alfalfa for hay or silage crops.

Alfalfa has been grazed alone or in mixtures since its introduction into the Americas. High yields, high quality, and perenniality make it the premium forage for conservation but it has not been utilized for grazing to any extent in the U.S. Grazing systems wholly based on alfalfa are used in the ewe-lamb industry of New Zealand and weaned lambs are often finished on pure alfalfa pastures. Alfalfa, with or without companion grasses, can be integrated into conventional beef cow-calf systems in the tall fescue zone using combinations of haying and grazing. Grazing of alfalfa is without doubt a key to a significant increase in the quantity and quality of the products of our grasslands.

Alfalfa Cultivars for Grazing - The best alfalfa varieties for grazing are those suited for hay and silage. Any high-yielding, long-lived variety is suitable for grazing if properly managed. One could speculate that breeders could develop alfalfa for grazing situations because commercially available lines of alfalfa are entirely unsuited to continuous grazing. Plant breeders, recognizing the advantage of tillering in grasses (a form of vegetative propagation), evaluated rhizomatous and creeping-rooted forms of alfalfa as types which may be long-lived and more persistent under grazing. To get at this genetic information breeders had to look at the hardy Medicago falcata species. Unfortunately these cultivars are slow starters in spring, begin winter dormancy early and are low yielders. Two available varieties are Cancreep and its derivative Cancreep II.

Grass Companions for Alfalfa in Pastures - Inclusion of a cool-season grass with alfalfa is a common practice in Kentucky. Grass-legume mixtures have several advantages over pure stands of alfalfa in grazing applications. Inclusion of grasses in alfalfa pastures seldom increases yield and is not likely to improve quality. Cool-season grasses retain their ability to grow

all year and will do so whenever soil/air temperatures exceed 40°F or so. This means that the grass may grow when alfalfa is dormant. Grasses extend the grazing season so that forage is available in the fall after the alfalfa goes dormant or is frosted down and the grass components green up earlier so forage is available earlier in spring. Grass-alfalfa stands have less run-off, less erosion, and less nitrate and phosphate losses than pure stands of alfalfa. Grasses reduce frost-heave and mortality of alfalfa plants when grown with alfalfa. Grasses occupy spaces otherwise colonized by weeds such as crabgrass, foxtail, henbit and chickweed. Grasses may also increase the drying rate of windrows, and improve self-thatching of large round bales. Bloat may be less likely in grass-alfalfa pastures.

Inclusion of grasses in a pasture with alfalfa has some drawbacks. Grass content reduces the average quality of the forage and it imposes some constraints on forage management. The ratio of grass/legume varies throughout the year, and it is affected by management so the amount and quality of forage may be more variable than that of a pure stand. Grasses tend to be more competitive than alfalfa for nutrients (such as potassium) and they may induce deficiencies in the legume. Fewer herbicides are available for weed control in alfalfa-grass pastures than in pure alfalfa pastures.

The choice of a compatible cool-season grass companion for alfalfa is simple. Orchardgrass is the best cropmate for alfalfa whether grazed or hayed. Tall fescue, timothy, and perennial ryegrass are all used in pasture associations with alfalfa but orchardgrass is the most easily managed. Timothy has been a favorite of some hay producers and it is quite a sociable companion under haying but it does not withstand grazing very well. Tall fescue may be the ideal companion for alfalfa in grazing systems for Kentucky. Dr. Timothy Taylor showed that tall fescue under continuous hay management succumbed to powdery mildew (Rhizoctonia) sheltered by the alfalfa canopy but under simulated grazing management the tall fescue made a significant contribution (about 25%) to yield. A low-endophyte tall fescue, such as Johnstone, may be highly suited to growth with alfalfa in pastures. We have no information as yet on the performance of low-endophyte tall fescue alfalfa pastures under grazing.

Maintenance of Alfalfa Pastures - Alfalfa pastures should receive maintenance applications of fertilizer according to estimated levels of productivity, with soil pH maintained above pH 6.3 by applications of limestone. Recommendations for hay or silage alfalfa should be followed (AGR. 1). Return of P and K in dung and urine could reduce maintenance levels but this can only be determined by periodic soil testing. Grass-alfalfa pastures may respond to urinary nitrogen return in terms of grass yield. The grass component also minimizes nitrate leaching and loss of phosphate by erosion.

Weed and Pest Control in Alfalfa Pastures - Grazing gives farmers a valuable biological weapon in their arsenal for their war on weeds and insect pests such as potato leaf hopper and alfalfa weevil. Alfalfa can be defoliated quickly by grazing in virtually all weather in contrast to mowing and applications of herbicides and insecticides which are highly weather dependent. Grazing schedules can be modified if weed or pest problems threaten the stand. The grazing option is particularly useful during alfalfa establishment, for weevil problems in early spring, and for weed control in dormant stands. Mismanagement of grazed stands by grazing too frequently

will lead to weed ingression, conversely proper management generally leads to purer longer-lived stands (Table 1). As noted in the section on grass-alfalfa pastures, fewer chemicals are available for weed control, but then fewer weeds are likely to be a problem. In grazed stands unpalatable weeds such as the pigweeds (Amaranthus sp) or docks (Rumex sp) may become a problem.

Table 1. Effect of stage of harvest on DM yields alfalfa and weeds (Hoglund et al. 1974).

Stage at cutting	Alfalfa	Weeds	Total
	----------lb/acre----------		
Prebud	2052	1213	3265
50% bud	3498	375	3873
First flowers	4497	54	4551

Yield of Alfalfa and Alfalfa-Grass Pastures Under Grazing - When properly grazed yields of alfalfa grass and alfalfa pastures are no different from those of fields taken for hay or silage. In some situations the grazed stands may yield more because of nutrients returned in the dung and urine. Mismangement of alfalfa stands during periods when forage is in short supply is likely to be more destructive than where tall fescue or other grass pastures are abused. As mentioned elsewhere grasses usually do not increase yields of alfalfa pastures, but they do give more resilience to managerial abuse.

Duration of Grazing of Alfalfa Pastures - A simplistic approach to the grazing of alfalfa is to mimic the best harvest management systems. The consensus of researchers and practitioners of the art of grazing of alfalfa is that the length of the grazing period should not exceed 12 days during periods of active growth. This is about the average time from the start of grazing until new crown shoots appear and become susceptible to damage by grazing and treading. This 'safe' period for grazing includes the 6 day lag phase from the time the stem tips are removed until the new crown buds become visible on close inspection of the crown. There are exceptions to the 12 day rule. When alfalfa is dormant new crown buds do not form and alfalfa can be grazed safely for longer periods. In times of drought as in the summer of 1983 and 1984, crown buds are suppressed (ie remained dormant) by water stress and grazing could be extended beyond 12 days without a significant effect on stand life. Following the fall freeze-down most alfalfa varieties available in Kentucky become dormant and crown shoots either do not form or form a rosette until they are frost-killed. In either case alfalfa is quite resistant to grazing and can be grazed for extended periods.

The 12 day rule can also be more liberally interpreted during the first cut. Alfalfa stands are healthiest and most active during the first crop as shown by their yield and quality. The first crop of alfalfa can be grazed at earlier stages and for longer than 12 days. The activity of alfalfa and the reserves of crown buds ensure stand survival provided the stand is allowed to recover. Virginia researchers suggest a 3-5 week grazing in early spring and the delay of the first hay harvest until more favorable drying weather for hay. If winter-and spring-germinating weeds threaten the stand, early

and extended periods of grazing may also be used as a means of weed control.

When grazing is extended beyond 12 days or so, during periods of active growth, new crown shoots are grazed off and/or damaged by treading. This reduces the stem population, the yield of the next crop, the population of crown buds held in reserve for subsequent crops, and it depletes and weakens crowns and roots and kills weaker plants. This reduces stand life and leads to grass or weed ingression. Continuous grazing in the worst possible management for alfalfa (Table 2).

Table 2. Effect of duration of grazing period on the dry matter yield of alfalfa (Janson 1976).

Grazing duration	Yield	*Stocking rate
days	lb/acre	steers/A
2-4	16327	190
15	14278	24
30	11599	10

*Converted to 750 lb stockers
*Grazing at beginning of flowering or crown shoot appearance

Grazing of alfalfa for short periods say 1 or 2 days, is not recommended as a long-term practice. When grazed repeatedly for short durations selective grazing results in increased proportions of less palatable and unpalatable species (Leach 1983). In Kentucky, weeds such as dock (Rumex spp), pigweed (Amaranthus spp), nimblewill (Muhlenbergia spp) and horsenettle (Solanum spp) are likely to increase in stands. Grazing for a minimum of 4-5 days is recommended to minimize selectivity and the growth of undersirable species. Another problem with very short grazing periods is the high stocking rates needed to graze alfalfa down quickly. This means either large herds or small fields (Table 2). In many farm operations a 7 day graze down with a 28-35 day recovery period is a workable system requiring 5-6 fields or subdivisions.

Length of the Recovery Period of Alfalfa Pastures - The length of the next period of grazed alfalfa or alfalfa grass pastures is similar to that recommended for harvested crops. During periods of active growth the rest period is determined by (a) the beginning of flowering, or (b) the presence of new crown shoots, or (c) lodging, or (d) infestation of alfalfa weevil or potato leaf hopper. In typical years this works out to a 4 to 5 week rest period for most varieties. Longer rest periods are necessary when growth is slow or alfalfa management call for it (eg. last cut).

Established alfalfa and alfalfa grass stands can sustain a certain level of mismanagement if herd nutrition is critical. Grazing and cutting too frequently, however, almost certainly reduces the population and size of alfalfa plants and weakens the stand (Tables 1,2).

Quality of Alfalfa for and During Grazing - The characteristics of alfalfa which define its high nutritional quality apply to alfalfa which is to be grazed. Almost without exception standing alfalfa exceeds the quality of any of its conserved forms (Table 3). As a grazed forage alfalfa has a high

concentration of both energy and protein with the protein levels often far in excess of that required by any grazing fiber digester. A high proportion (90% or more) of the ingested plant protein is degraded in the rumen to urea with that which is in excess of needs of the rumen microflora being excreted as urinary nitrogen. Livestock with a high demand for protein often do well when grazing alfalfa for the high protein content, intake, and rate of passage ensure more bypass protein.

Table 3. Typical nutritional characteristics of fresh alfalfa (NRC 1984)

	Stage of growth			
	Late vegetative	Early bloom	Mid-bloom	Full bloom
1. DE (M cal/kg)	2.78	2.65	2.56	2.43
2. TDN (%)	63	60	58	55
3. CP (%)	20.0	19.0	18.3	14.0
4. Cell Wall (%)	38	40	46	52
5. Cell content (%)	62	60	54	48
6. ADF (%)	29	31	46	52
7. Lignin (%)	7	7	9	10

Alfalfa has a high lignin content compared with forage grasses and this is a major detractor of quality. Lignin is a strengthening agent in cell walls. Lignin increases rapidly as cells (or crops) mature and especially as the proportion of stem rises. Fortunately alfalfa has a relatively low proportion of its dry matter in the cell wall fraction (Table 3) compared with forage grasses and this means that it has a high content of the rapidly and completely digestible cell contents. The shape of the trifoliate leaves of alfalfa and other physical characteristics of the crop reduce rumination time and the energy expended in the effort of grazing. The physical and chemical properties of alfalfa contribute to a high rate of digestion and passage through the gastrointestional tract and this contributes to high herbage intakes.

Alfalfa stems mature, flower, set seed, and die if permitted to do so. During this natural progression, quality in terms of significance to the grazing ruminants, deteriorates quickly, especially after first flower (Table 3). Herbage intake falls off as quality declines in terms of both its chemical characteristics and physical properties (especially ratios of leaf/steam and living/dead tissues). Intake and performance of grazing ruminants then is a function of the stage of maturity of alfalfa at the commencement of grazing. The quality parameters of grazed alfalfa are essentially the same but better than those of alfalfa harvested for hay or silage. Short grazing periods minimize the effects decline in quality during the grazing period due to maturation.

Initially, selective grazing increases the quality of ingested alfalfa above that of the quality of the standing crop as a whole, but as the amount of herbage mass declines the average quality falls below that of the crop as a whole. Alfalfa, if grazed at recommended stages of growth and stocking rates, is eaten by cattle in horizontal planes (3-4" deep or so) from the canopy down, first defoliating the growing points and the younger topmost leaves (Table 4). As the harvesting mouth moves to successively lower planes, fewer and older leaves are ingested along with more and older stems.

Herbage intake of grazed alfalfa is highest on the first day of grazing and declines each day thereafter. Animal performance follows these trends. The implication is that grazing periods of a few days would be more likely to maintain uniform live weight gains. These characteristics also imply that Blaser's concept of leaders and followers may give best utilization of grazed alfalfa. This could be running stockers ahead of cows and calves for 3-4 days each or creep grazing calves ahead of cows.

Table 4. Dry matter composition of alfalfa before and after grazing by beef steers (Alder & Minson 1963)

	Flower buds	Top 4"	Leaf	Stem
		%		
Before grazing	3.1	17.6	21.3	58.0
After grazing	0.0	5.4	9.4	85.2

Utilization of Alfalfa Pastures - When alfalfa or alfalfa-grass pastures are grazed they should be grazed down as close as possible. If alfalfa is grazed off within 7 days this means very rapid changes in herbage mass, allowance per animal, and forage quality. Utilization by grazing should approach 80% or so and this results in a drastic reduction in herbage intake per animal. This is one reason we suggest creep grazing of cows and calves or a system of leaders and followers. If alfalfa is not grazed down hard residual leaves and stem buds suppress the activation of the next flush of crown buds and the yield of the next crop is diminished. If farmers choose not to finish off a field by grazing they should consider clipping. Sprayings of paraquat immediately after grazing would achieve the same objective if weeds are a problem but this is only recommended in pure alfalfa pastures.

Animal Problems Associated with Grazing of Alfalfa - A concern of most beef cattle producers contemplating grazing of alfalfa is the possibility of bloat (Bovine typanites). The incidence of bloat in cattle grazing alfalfa is quite low and is generally less than that experienced by cattle on red or white clover. Addition of grasses, such as orchardgrass, to the seeding mixture may reduce the chance of a bloat outbreak. Bloat preventatives such as poloxalene are effective and easy to use and readily available. These substances can be administered in the water supply, in mineral supplements, or directly to bloat victims.

Another problem associated with the grazing of alfalfa by sheep, but not reported for beef cattle, is related to the level of phytoestrogens in the forage. Sheep producers are advised not to graze alfalfa during flushing, mating, and conception because high estrogen levels reduce ewe fertility. Plant estrogens are exceptionally high in alfalfa with severe foliar diseases. New resistant cultivars are less likely to cause this problem. The infertility problem is particularly important in high fertility flocks (140-200% lambing) and not so important in low fertility flocks. The estrogen effect may not be expressed in beef cow herds where calving is usually less than 95%.

Sodium levels in alfalfa are usually in the vicinity of 0.15% and should meet the nutritional needs of grazing animals (0.08%, NRC 1984), however, sodium deficiencies have been reported in stock grazing pure stands of

alfalfa. Low sodium status could occur on low sodium soils where potassium levels are maintained at levels to maximize yield. Sodium uptake by the plant is suppressed by potassium and sodium excretion by the animal is accelerated by high concentrations of dietary potassium. Weed-face stands of alfalfa under high yield management are also likely candidates for sodium deficiency. Alfalfa-grass pastures are less likely to cause this problem. Mineral supplements are recommended to the conservative manager (perhaps with bloat preventatives).

Copper deficiency is a potential problem of ruminants grazing alfalfa in Kentucky. Copper levels of 4-10 ppm in the diet are thought to be sufficient to meet the requirements of beef cattle (NRC 1984). Levels of copper as low as 3 ppm have been found in alfalfa in Kentucky. Alfalfa is quite rich in molybdenum, sulfur, phytate and lignin and these may interfere with copper absorption and induce copper deficiency in the grazing annual.

Selenium deficiency is not likely to occur in animals grazing alfalfa because of the relatively high concentration of selenium and vitamin E in fresh alfalfa (NRC 1984). Deficiencies in sodium, copper, and selenium are easily and cheaply corrected by appropriate mineral supplements. Nutritional problems generally are less likely to be expressed in pure, weed-free stands or in grass-alfalfa pastures.

Alfalfa and Alfalfa-Grass Pasture Systems for Beef Producers - We have established that the grazing period on alfalfa should not exceed 12 days and that the recovery period should be about 4-5 weeks to ensure a satisfactory level of productivity and a long stand life. A workable system for beef producers in Kentucky is to have 5 or 6 alfalfa pastures. Temporary electric fences can be used to subdivide larger fields is necessary. Grazing should begin on the first field about the last week in April and the herd moved to the next field in rotation on the same day one week later. The grazing period of 1 week with a rest period of 4 or 5 weeks gives some flexibility and allows surplus alfalfa to be made into hay. Alfalfa fields should be grazed in strict rotation until mid-September when cattle should be moved to tall fescue or other pastures to accomodate fall management of the alfalfa. Cattle should be returned to alfalfa by mid-October following freeze-down. If alternative forage is available (eg pasture, stubbles, sorghum-sudan) cattle can be withdrawn from alfalfa rotation and a haying schedule imposed with the same weekly harvest interval.

The productivity of alfalfa and its quality are suited for calving later in spring than beef cow systems on tall fescue. Alfalfa is not well suited to fall calving systems. Creep grazing calves ahead of the herd is likely to be useful as long as grazing duration does not exceed 12 days. Stockers could be run ahead of cows and calves and calves creep-grazed if management permits.

Productivity of Beef Cattle on Alfalfa Pastures - Average daily gains (ADG) of up to 3 lb/day have been recorded on steers grazing alfalfa or alfalfa grass pastures with conversion ratios of near 8 lb of forage per lb of gain (Walton et al. 1981). The combination of high yield and high quality of alfalfa and alfalfa grass pastures ensures intakes of herbage with a minimum effort of grazing and this leaves more energy for gain. This was demonstrated in some work done at UK this past summer where voluntary intake was measured on steers grazing alfalfa and tall fescue (Table 5). Steers on

alfalfa took 25-30 bites per minute while those on alfalfa took 45-50 bites per minute. The average bite size of steers on alfalfa was 50% more than those on tall fescue. It should be noted that the tall fescue was virtually free of endophyte and was composed of leafy regrowth while the alfalfa was in advancing stages of flowering.

Table 5. Characteristics of intake of Angus steers grazing alfalfa or tall fescue (UK 1984).

	Grazing time	Biting rate	Bite size	Ingestion rate
	hours	bites/min	lb DM/1000 bites	lb DM/hour
Alfalfa	4	25-30	1.5	2.25
Tall fescue	4	45-50	1.0	2.75

Best performance in terms of animal yield are achieved when alfalfa is grazed during the vegetative stage but this could lead to stand deterioration. The best compromise is to graze at the first bud to 1% flower stage. NRC (1984) standards were used to calculate intake and ADG of mediume frame beef steers on alfalfa as it matured (Table 6). These calculations show the decline in quality and its effect on intake and ADG. The performance of these steers is about half of that recorded in actual grazing experiments.

Table 6. Effects of maturity on forage quality, intake, and average daily gain of 600 lb steers on alfalfa (NRC 1984).

Stage	TDN %	Intake lb DM/day	ADG lb/day
Vegetative	63	14.7	1.52
Early bloom	60	14.3	0.81
Mid bloom	58	14.0	0.56
Late bloom	55	13.4	0.31

Research at VPI showed that steers ingested more drymatter each day from alfalfa orchardgrass pastures than from conventional red clover - tall fescue pastures or bluegrass - white clover pastures (Table 7)

Table 7. Properties of three grass legume forages and daily drymatter intake of steers (Thompson et al. 1984).

	Alfalfa Orchardgrass	White clover Bluegrass	Red clover Tall fescue
Crude protein (%)	14.1	15.8	13.1
NDF (%)	66.4	69.7	70.4
ADF (%)	36.3	37.6	38.4
DMD (%)	52.7	52.0	48.7
DM intake (lb/day)	13.2	12.1	9.7

In a grazing experiment at the Woodford farm of the University of

Kentucky from 1962-1966 Kentucky bluegrass-alfalfa pastures supported beef steers for 60% more grazing days and produced about 60% more liveweight gain than bluegrass-white clover pastures (Table 8).

Table 8. Productivity of alfalfa-bluegrass and white clover-bluegrass pastures in Kentucky (Templeton et al. 1970).

Pasture	Grazing days Steers/acre	ADG lb/day	LWG lb/acre
Alfalfa-bluegrass	460	1.24	536
Clover-bluegrass	280	1.24	340

Conclusions

1. The management and technology is available to use alfalfa pastures for beef cattle production.

2. Simple rotational grazing systems using as few as 5 or 6 subdivisions are necessary to utilize alfalfa pastures.

3. Grass-alfalfa pastures may be more easily managed than pure alfalfa pastures.

4. Alfalfa and alfalfa grass pastures can produce more gain per acre than other permanent pastures.

5. The high phosphate limestone-based soils of parts of Kentucky have a distinct advantage for alfalfa-based grazing systems.

6. A combination of alfalfa (or alfalfa-grass) pastures with endophyte-free tall fescue pastures is likely to be the best pasture system for beef cow-calf production in Kentucky.

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