BALANCING YIELD, QUALITY AND PERSISTENCE

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ABSTRACT

An objective of every alfalfa grower is to maximize both yield and quality to receive optimum returns without jeopardizing stand life. However, yield and quality are typically inversely related; the highest quality is almost never associated with the highest yield. Since quality affects price and animal production, growers must discover a compromise between yield and quality to maximize profit. Achieving maximum returns involves a difficult balancing act weighing the benefits of early cutting for forage quality against the negative effects of early cutting on total yield and stand persistence. Quantification of the amount of yield gained vs. the amount of quality lost with each management decision will aid in optimizing profitability. While the implications of the yield/quality tradeoff cannot be completely avoided, strategies to consider for boosting profits are outlined. 'Staggered' cutting schedules which target some harvests for quality and others for yield and stand life may be an effective approach. Using this strategy, fields are given 'rest' periods, which benefit the health of the root and crown, and therefore improve stand persistence. Alternating the number of cuttings from one year to the next may also help maximize quality, while giving the plants a rest in the year fewer cuts are made. Producing a more dormant variety on some fields is an alternative strategy to produce high quality provided the yield penalty associated with the more dormant variety is not too great. We suggest that no single strategy (e.g. cutting only for yield or only for quality) is optimal, but mixed strategies which assure a supply of both high and medium quality hay may be reasonable and sustain crop production and profitability over time.

Key Words: Alfalfa, *Medicago sativa*, harvest management, cutting schedules, forage quality, varieties, economics, ADF, NDF CP

INTRODUCTION

A fundamental and unavoidable reality of alfalfa production is that yield and quality are inversely related. As yield increases quality generally decreases and visa versa. This is generally true for many production practices such as irrigation management, fertility, and to a large degree, even variety selection. However, it is particularly true when it comes to harvest timing. Alfalfa cut at immature growth stages (i.e., pre-bud or early bud) has high forage quality but yield suffers. This phenomenon is often referred to as the yield/quality tradeoff and represents a real dilemma for the alfalfa producer who obviously seeks both high yield and high quality at the same time. Harvest timing (the maturity at which the alfalfa is harvested) is the most powerful tool under the grower's control to determine both yield and quality, and thereby the profitability of alfalfa production. Here, we consider the impact of harvest timing as a

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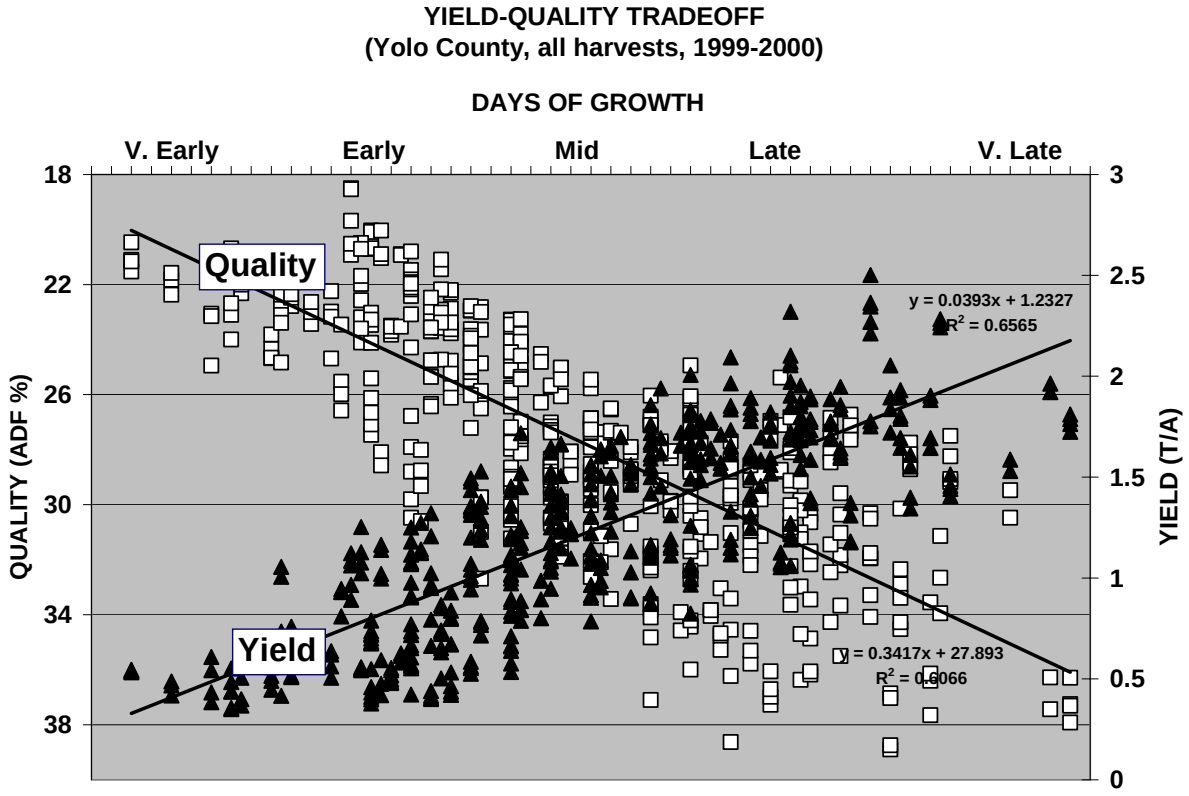
primary determinant of the yield-quality tradeoff, and its implications for economic returns and stand persistence.

YIELD/QUALITY TRADEOFF

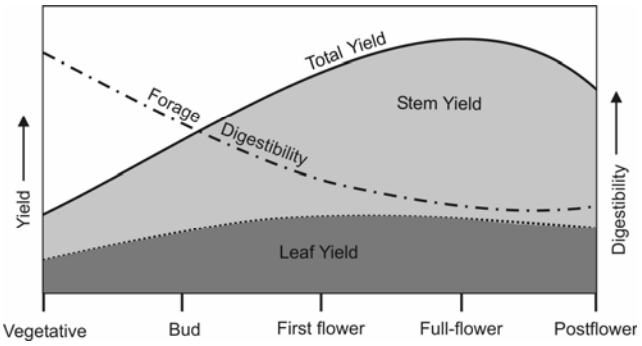
The yield/quality tradeoff is illustrated in Figure 1. These data are from Yolo County in the Sacramento Valley of California. While these results mainly pertain to the Sacramento Valley, the general relationship between yield and quality holds true for any area where alfalfa is grown. There is a linear increase in yield as alfalfa matures from very early to very late growth stages. This means that the rate of increase in yield is relatively constant as alfalfa matures during the "normal" harvest window. In contrast to yield, there is a linear decline in forage quality as alfalfa matures.

Figure 1. The effects of harvest timing on the yield and forage quality of alfalfa hay in Yolo County, CA (1999-2000). While the scatter of these datapoints represents the different seasons of the year and different years, the clear relationship between days of growth and both yield and quality can be seen in the lines. Quality ranges from very low fiber (high quality) in immature forage, but with low yields, to high fiber (low quality) associated with higher yields. (T. Ackerly data, UC Davis)

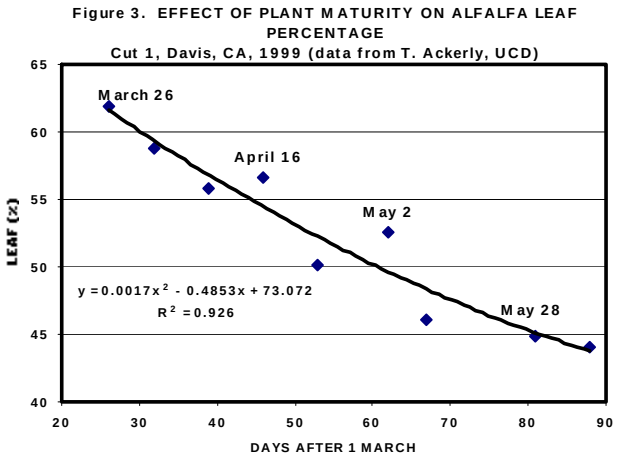


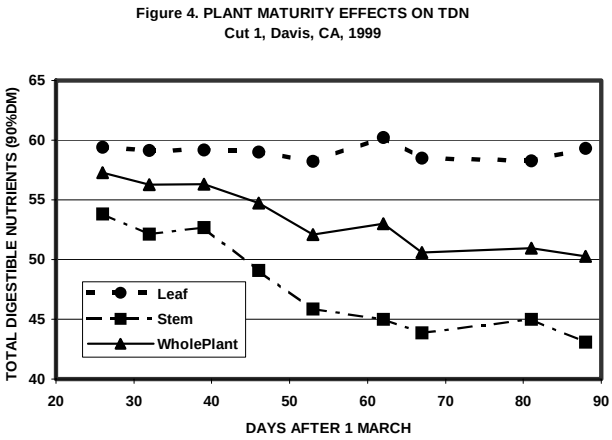
To better understand the yield/quality tradeoff, it is helpful to consider the morphological changes that occur as alfalfa matures (Figure 2). The yield of leaves increases until late vegetative to early bloom and remains relatively unchanged after that. There may even be a decrease in leaf yield approaching full bloom due to leaf loss from the lower portion of the canopy. On the contrary, stem yield continues to increase as alfalfa matures. Leaf yield and stem yield are often nearly equal at the late vegetative stage. However, since stem yield continues to increase rapidly, stems often make up 60% and leaves only 40% of the total yield at the late flowering stage of alfalfa development (Figure 3). This has important ramifications for alfalfa forage quality because the nutritional value of alfalfa leaves far exceeds that of stems. This difference in the relative proportion of leaves and stems accounts for much of the decline in quality that occurs as alfalfa matures.

Figure 2. Relative forage yield and quality at different alfalfa growth stages.



Not only do stems make up a greater proportion of the total yield as alfalfa matures, the digestibility of the stem material itself also declines with advancing alfalfa maturity. The fiber content of the stems increases, especially the lignin content, which is the least digestible fraction of the fiber. The digestibility and crude protein concentration of stems declines more rapidly than it does with leaves (Figure 4).





STAND PERSISTENCE

Cutting frequency not only affects yield and forage quality, but has a profound influence on alfalfa vigor and ultimately can even affect stand persistence. Alfalfa stores some of the carbohydrates produced in photosynthesis, as well as protein and minerals in its crown and root—commonly referred to as root reserves. These nonstructural carbohydrates provide the energy for survival through winter, growth in the spring, and regrowth after cutting. During these periods an alfalfa plant draws on carbohydrates from roots until new leaves can photosynthesize carbohydrates sufficient to exceed the needs of the growing plant. This does not usually occur until the alfalfa attains a height of 6 to 8 inches after cutting. From that point on carbohydrates in the root and crown gradually increase until full bloom.

Frequent harvest of alfalfa is an important cause of stand loss. Repeatedly cutting alfalfa at immature growth stages does not allow sufficient time for the plant to replenish nonstructural carbohydrates in the root. If this occurs over a prolonged time period, especially over several years, stand persistence may be reduced. A reduction in stand persistence with short cutting intervals has been noted in numerous research trials. This occurs in both cold and mild climates, and is illustrated by the data in Table 1. Alfalfa harvested at prebud stage (21 days) produced stands that were 52% of those harvested at 50% bloom at Davis, CA (Table 1). Going into winter with inadequate carbohydrate reserves reduces winter hardiness—a significant factor in cold short-season alfalfa production areas.

Table 1. Effect of Maturity at harvest and harvest interval on alfalfa yield, quality, and leaf percentage weeds and stands life.

Maturity at Harvest	**Harvest Interval**	**Yield**	**TDN**	**ADF**	**CP**	**Leaf**	**Weeds**	**Stand**
	(days)	T/acre	----------%----------					
Pre-Bud	21	7.5	56.3	26.3	29.1	58	48	29
Mid-Bud	25	8.8	54.2	29.5	25.2	56	54	38
10% Bloom	29	9.9	52.4	32.2	21.3	53	8	45
50% Bloom	33	11.4	52.0	32.7	18.0	50	0	56
100% Bloom	37	11.6	50.1	35.5	16.9	47	0	50

Source: V.L. Marble, 1974. Proceedings, 4th CA Alfalfa Symposium, Dec. 4-5, 1974. UC Cooperative Extension.

PEST RESISTANCE

The reduction in vigor associated with continuously cutting alfalfa at immature growth stages can alter the plant's ability to withstand pests. Alfalfa cut on a short cutting schedule is generally less able to withstand pests than alfalfa cut with a longer interval between cuttings. For example, far more Egyptian alfalfa weevil injury occurred in research plots cut at a short harvest interval compared with plots cut less frequently. Similarly, weed infestation in late summer, winter and spring was dramatically higher when alfalfa was cut frequently (Table 1).

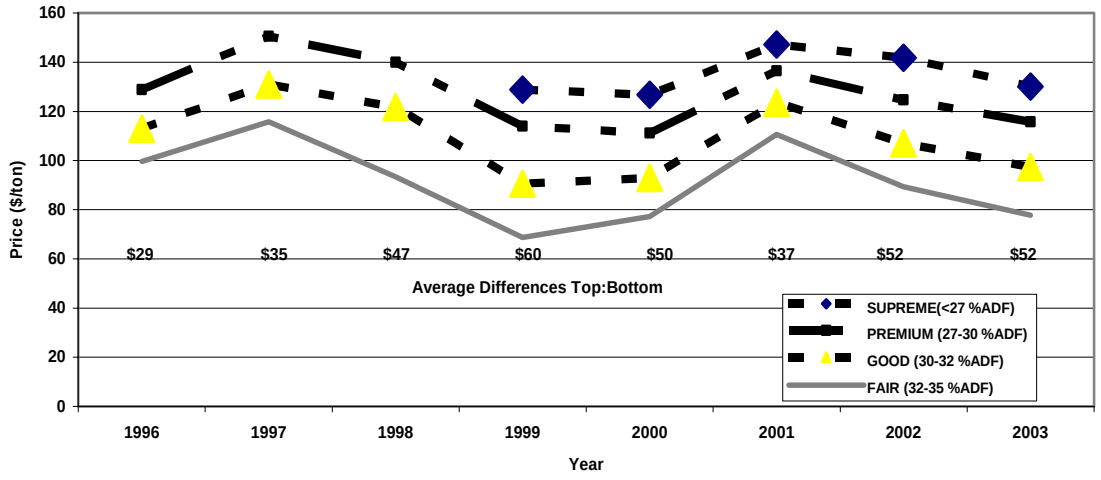
MARKET FACTORS AND ECONOMIC COMPARISONS

In cash-hay markets, the selling price for alfalfa in a given year has a profound effect on which cutting strategy is most profitable. Alfalfa prices vary considerably from year to year so the best cutting strategy for one year may not be best in another year. The larger the price spread between top quality alfalfa and the lower grades, the greater is the incentive to employ a more aggressive cutting strategy.

Somewhat surprisingly, the price spread between high quality "dairy" quality alfalfa and lower quality alfalfa tends to be greatest in low price years. Figure 5 shows average annual alfalfa hay prices in California from 1996 to 2003 for the different classes of alfalfa hay. Years with the highest hay prices (1997 and 2001) had the smallest price spread between top and bottom hay quality categories with the exception of 1996, which for some reason had moderate prices but the lowest price spread between qualities. Conversely, low prices resulted in the greatest price spread, both in absolute dollar amounts, and as a percentage of the average. Hay prices were lowest in 1999, especially for 'Fair' quality alfalfa. Consistent with this trend, this year had the greatest price spread between top and bottom hay quality categories ($60 per ton). It appears that in high price years, alfalfa consumers are less demanding and are willing to lower their standards more than in low price years. This phenomenon is most likely a function of supply and demand factors, both overall supply and supply/demand in each product category.

Wide swings in the price spread between quality grades from year to year suggest that growers should alter their cutting strategy depending on market conditions. Therefore, in years such as 1999, 2000 or 2003 it is much easier to justify cutting early to achieve maximum forage quality than it is in high price years such as 1997 or 2001 or 2004 (complete data for 2004 not yet available), where it may be better to delay cutting to maximize yield.

Figure 5. Effect of forage quality on hay prices (Ave. of all California Markets, 1996-2003



BALANCING THE YIELD/QUALITY TRADEOFF

The goal of every alfalfa grower is to maximize **both** yield and quality to receive optimum returns without jeopardizing stand life. However, given the indisputable existence of the yield/quality tradeoff this is difficult to accomplish in practice. Concessions must be made, as it is not feasible to maximize yield and quality simultaneously.

Growers—especially those who sell their hay to the dairy market—are forced to cut early to attain the required forage quality. Forage quality standards have become more rigorous over the years and the yield penalty for such early cutting can be severe. While the implications of the yield/quality tradeoff cannot be completely avoided, there are strategies to consider for boosting profits in different environments. Three different approaches are outlined below from the Midwest (Additional Late-Season Cut), the Intermountain area of Northern California (Staggered Approach), and the California's Central Valley (Fall Dormancy Cutting Schedule Interaction).

Additional Late-Season Cut (Cold Climates)

Considerable research has been conducted in the Midwest to evaluate different cutting schedules. The cutting management decision is further complicated by the possibility of winter injury in this area. The risk of winter injury is much greater with frequently-cut alfalfa stands that must survive the winter with depleted carbohydrate reserves. Therefore, the recommendation has been to harvest the last cutting near the first week of September so that the alfalfa has about 6 weeks growing time to replenish root reserves before the first killing frost. This would typically involve cutting the alfalfa three times (very early June, mid-July and very early September).

An alternative strategy that can in some years increase total production and improve quality is to cut the alfalfa four times rather than three (Table 2). A 4-cut system with the last two cuttings on September 1 and October 15 produced as much or more than other cutting schedules, and the forage quality (digestible dry matter and crude protein) tended to be higher. The key is the timing of the last cutting of the season. Mid-October is typically the time of the first killing frost so by cutting at this late date there is minimal chance for regrowth to occur that depletes carbohydrate reserves. Cutting in mid to late September allows alfalfa to regrow, but there is insufficient time to replenish carbohydrate reserves and for the plant to obtain a high level of dormancy. However, if alfalfa is cut four times by September 1st the short cutting frequency depletes carbohydrate reserves potentially reducing winter survival and vigor the following spring. Therefore, the 4-cut system with the final cutting in mid-October has merit for maximizing yield and improving season average forage quality slightly without excessively depleting carbohydrate root reserves. With favorable September growing conditions, growers can achieve about a ton per acre of high quality alfalfa at the October cutting.

The biggest challenge with this system is curing the alfalfa during mid-October weather conditions. This approach may have more merit where the feed is used on the ranch and is preserved as silage or fed as greenchop instead of hay. However, in many of the cold climates of the West, alfalfa producers do not have livestock and produce hay which is transported relatively long distances to dairies.

Table 2. Effect of cutting frequency and timing on total season yield and season average forage quality of alfalfa at Rosemount, MN (average of two 3-year experiments).

Cuts per Year	Avg. Cutting Dates	Avg. Total Season Yield	Yield Range	Season Avg. Digestible DM	Season Avg. CP
		--------Tons DM/acre--------		----------%	
3	6/4, 7/14, 9/1	4.9	3.9-6.2	59	18
	6/4, 7/14, 9/15	4.7	3.5-5.7	57	18
	6/4, 7/14, 10/15	4.8	3.5-5.8	54	17
4	5/24, 6/25, 8/4, 9/1	4.1	2.9-5.4	65	21
	5/24, 6/25, 8/4, 9/15	4.4	2.9-5.9	64	20
	5/24, 6/25, 8/4, 10/15	4.5	3.2-5.3	60	19
	6/4, 7/14, 9/1, 10/15	5.1	3.9-6.2	60	19
LSD (0.05)		*0.4*		*2*	*1*

Source: Sheaffer, C.C., and G.C. Marten. 1990. J. Prod. Agric. 3:486-491.

Staggered Approach

It is extremely difficult to produce "dairy quality" alfalfa hay on all fields throughout the entire season. Given the number of fields many growers have, it typically takes weeks to harvest a single cutting over the entire ranch. The first fields harvested may meet dairy quality standards while those harvested later often fall short. It is especially difficult to produce high quality alfalfa in midsummer. The usual approach is to harvest fields in sequential order from one cutting to the next reducing the interval between cuttings in midsummer to account for the rapid alfalfa growth rate at this time of year.

The worst outcome is for growers to attempt to obtain high quality, but just miss it, and therefore have **both** low quality and low yield. This is a frequent outcome of many growers' cutting strategies in California. Due to logistical considerations or weather, they often just miss the 'high quality' mark, at least as far as the markets are concerned. A strategy to avoid this fate involves the use of *staggered* harvests. The order in which fields are harvested is altered from one cutting to the next so that 'Quality' harvests are alternated with 'Yield' harvests. Using this approach the field cut first on first cutting will not be the first one cut on second cutting. A field that was cut in the middle of the sequence on first cutting will be the first one cut on second cutting. This helps assure that the alfalfa in the first fields cut will be immature enough to test dairy quality even in midsummer. Using this altered cutting sequence, fields cut first on first cutting have a longer interval between first and second cutting. These fields will obviously not test dairy quality. The intent is to maximize yield on these fields and give the plants an opportunity to recover from being cut at an immature growth stage on first cutting.

Research was conducted to evaluate the yield and quality of alfalfa harvested with a sequential harvest versus a staggered approach. Six treatments (6 plots with 4 replications) were used to designate a farm. The six plots were cut in a sequential or staggered order. The sequential plots were cut in the same chronological order at each cutting. For the staggered plots, the order was altered so that the plot cut 4th on first cutting was cut 1st on second cutting, the plot cut 5th on

first cutting was cut 2nd on second cutting, and the plot cut 6th on first cutting was cut 3rd on second cutting. The order for second cutting then continued with the plots cut 1st, 2nd, and 3rd on first cutting. Using this approach, the first three plots cut were relatively immature for high quality and the others had a longer growing period for maximum yield. The cutting order for third cutting returned to the same order as was used for first cutting.

The total average yield for the six treatments representing the sequential approach (all replications of the six plots averaged and totaled for the season) was the same as the total for the staggered plots. Of the three-cut schedules, the staggered system had the overall highest yielding plots for the season (staggered plots 1, 2 and 3) and the lowest yielding plots (staggered plots 4, 5, and 6). These plots balanced each other so that the total seasonal yield was the same for both approaches. The three 4-cut plots had the highest total yield. In many areas because of the short growing season it is not possible to make four cuts on all fields, especially in some years. Therefore, a reasonable approach may be to take four cuts on half the ranch and three cuts on the other half.

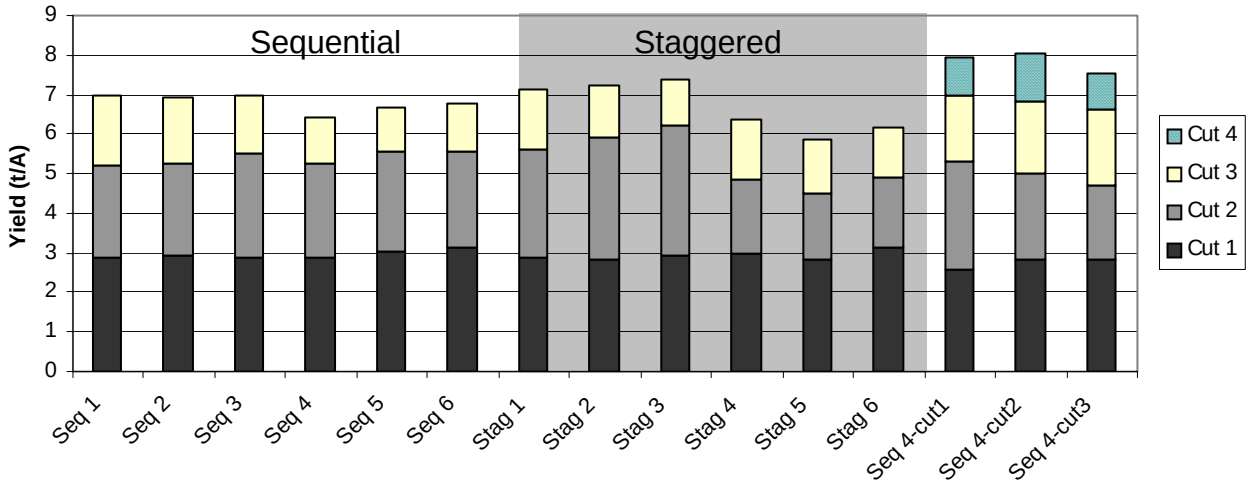


Figure 6. Yield comparison of sequential and staggered 3-cut systems and a 4-cut system. (Numbers 1-6 signify different plots intended to represent various fields on a grower's farm.)

The staggered 3-cut system had significantly more high quality alfalfa than the sequential approach. The staggered strategy resulted in some 'Supreme' and 'Premium' quality alfalfa on second cutting, whereas all the second-cutting alfalfa with the sequential cutting order was 'Fair' quality. The staggered system also resulted in more 'Supreme' and 'Premium' alfalfa on third cutting than the sequential approach. Over the season, five more plots (simulated fields) had 'Supreme' or 'Premium' using the staggered approach. Therefore, the staggered cutting order would increase revenue over the sequential order because the quality was higher while the yield was the same for both systems. Approximately 90 percent of the alfalfa in the 4-cut system was 'Supreme' or 'Premium'. The 4-cut system had higher total yield and superior forage quality. However, as noted above it is often not possible to cut all fields four times in short-season areas. Therefore, alternating between three and four cuts from one year to the next may be an effective

strategy to maximize yield and quality, while giving the plants a 'rest' to replenish carbohydrate root reserves in the 3-cut years.

Table 3. The effect of cutting strategy (sequential and staggered 3-cut systems and a 4-cut system) on the ADF content of alfalfa hay. (The field numbers 1-6 signify different plots intended to represent various fields on a grower's farm.)

Strategy	Field	ADF %			
		Cut 1	Cut 2	Cut 3	Cut 4
Sequential	1	26.1	31.8	30.4	–
	2	25.0	31.5	29.8	–
	3	26.1	31.1	26.3	–
	4	30.1	32.0	27.6	–
	5	29.5	31.9	24.8	–
	6	30.1	29.3	23.8	–
Staggered	1	25.5	32.4	26.3	–
	2	25.6	32.4	25.1	–
	3	27.1	30.5	24.1	–
	4	28.9	27.4	28.6	–
	5	29.9	26.9	27.1	–
	6	29.1	27.8	26.2	–
4-Cut	1	25.2	29.5	27.2	24.0
	2	24.9	26.6	27.4	22.4
	3	26.2	27.3	27.3	23.7

<27 ADF **Supreme** **27-29 ADF** **Premium** **>29 ADF** **Good & Fair**

VARIETIES AND CUTTING SCHEDULES

The use of 'high quality' varieties has been proposed as a method to achieve high forage quality. However, as with cutting schedules, the 'yield quality tradeoff' must be considered. There is strong evidence that high forage quality often comes at the expense of yield. Growing more dormant alfalfa varietie is a strategy that is sometimes considered to achieve higher forage quality. Historically, the fall dormancy score (FD) of alfalfa varieties grown in the Central Valley of California ranges from 6 to 9. However, with increased emphasis on forage quality and the difficulty producing 'Supreme' and 'Premium' quality hay, some growers plant more dormant varieties (as low as FD 4). The concept is that these varieties recover more slowly after cutting and will be less mature on a given day than their less dormant counterparts. A less mature plant at harvest equates to higher forage quality.

Studies recently conducted at UC Davis indicate the powerful influence of fall dormancy on both yield potential and forage quality (Figure 7). In our studies, more dormant varieties (FD 2-4) produced lower fiber (approximately 2 points ADF) and higher protein forage (approximately 2 points CP) than nondormant lines (FD 8-10). However, yields were almost always lower with

the more dormant varieties. The average yield penalty for each unit of FD ranged from about 0.3 tons/acre to 0.6 tons/acre per year per unit of FD in these studies—total annual yield differences of up to 3.5 tons/A between some varieties.

Cutting intervals varying from approximately 24 days to 33 days between cuts had a stronger influence on quality in this trial than did variety. *Early* cutting schedules resulted in 85% production in the 'Premium' and 'Supreme' categories, whereas *Medium* and *Late* cutting schedules resulted in 53% and 45% of the production in those categories, respectively in 2002 (average of 18 varieties).

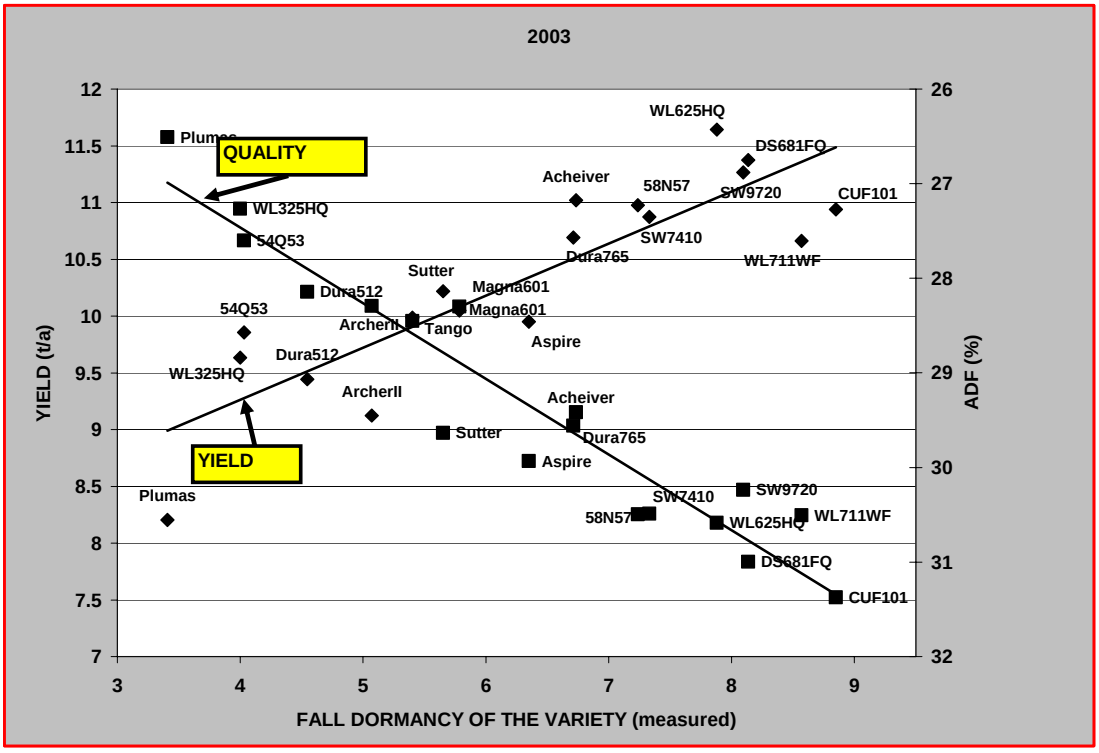


Figure 7. The yield-quality tradeoff in alfalfa as influenced by variety, data averaged over the season and three different cutting schedules (6, 7 and 8 cuts) and 3 replications (UC Davis data, 2003).

Growers need to determine the amount of yield loss that can be sacrificed for higher quality under different market conditions, since under some market conditions the yield sacrifice is justified while in other market conditions it is not. While selecting varieties with lower FD has the potential to improve quality, the tradeoff between yield and quality is a fundamental issue when choosing a variety for improved forage quality.

Economic Approach to the Question of the Yield-Quality Tradeoff. A full economic analysis of the tradeoff between yield, quality, and stand life is difficult and highly subject to regional factors and assumptions. However, a preliminary economic analysis of yield-quality cost-benefit choices may indicate the potential profitability of different strategies and help guide management decisions. An estimate of the yield penalty associated with different management

strategies used to improve forage quality is needed. The estimate may be obtained through experience or by using data from alfalfa variety trials or cutting schedule tests. For example, let's assume that a grower expects a yield of 1.6 tons if he uses the current cutting strategy. He estimates that if he cuts earlier to achieve 'Supreme" quality, yield will be reduced by 0.2 tons/A. Table 4 indicates that the minimum price improvement needed to justify cutting earlier is 14.3 percent. If the price for 'Premium' hay is $120 per ton and the price for 'Supreme' hay is $135 per ton, that equates to a 12.5 percent improvement in price—not enough to justify cutting earlier for 'Supreme" quality alfalfa. However, if the "price for 'Supreme' quality alfalfa is $140 per ton there is a 17% price improvement and earlier cutting is more profitable.

This table can be used to compare any two management practices that would bring about a difference in yield and quality/price. The management decision could be whether to employ a more aggressive cutting schedule or it could be whether to plant a more dormant alfalfa variety to achieve higher quality. The analysis can be performed for a single cutting or for the entire season. Using different yield and price assumptions, the grower can estimate which management option would more often result in higher returns.

Table 4. *Percentage price improvement required to justify a yield decline due to variety choice, cutting schedule, or other agronomic practice that results in potentially greater forage quality (and hence value) but decreased yield. Instructions: to compared 2 varieties or practices, 1) choose starting yield at left (higher yielding variety or practice), 2) Determine likely yield reduction in tons per acre, 3) The amount shown is the minimum percentage price improvement needed to justify that reduction in yield. If the likely price increase is insufficient, choose the higher yielding option. If the price increase due to quality exceeds this amount, choose the lower yielding (higher quality) option. This table assumes no change in production costs for either option.*

Starting	**Reduction in Yield (t/a per Cutting Basis)**										
Yield t/a	**0.05**	**0.1**	**0.15**	**0.2**	**0.3**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1**
	Minimum Percentage Price Improvement Required										
0.4	14.3	33.3	60.0	100.0							
0.6	9.1	20.0	33.3	50.0	100.0						
0.8	6.7	14.3	23.1	33.3	60.0						
1	5.3	11.1	17.6	25.0	42.9	100.0					
1.2	4.3	9.1	14.3	20.0	33.3	71.4	100.0				
1.4	3.7	7.7	12.0	16.7	27.3	55.6	75.0	100.0			
1.6	3.2	6.7	10.3	14.3	23.1	45.5	60.0	77.8	100.0		
1.8	2.9	5.9	9.1	12.5	20.0	38.5	50.0	63.6	80.0	100.0	
2	2.6	5.3	8.1	11.1	17.6	33.3	42.9	53.8	66.7	81.8	100.0
2.2	2.3	4.8	7.3	10.0	15.8	29.4	37.5	46.7	57.1	69.2	83.3
2.4	2.1	4.3	6.7	9.1	14.3	26.3	33.3	41.2	50.0	60.0	71.4
2.6	2.0	4.0	6.1	8.3	13.0	23.8	30.0	36.8	44.4	52.9	62.5
2.8	1.8	3.7	5.7	7.7	12.0	21.7	27.3	33.3	40.0	47.4	55.6
3	1.7	3.4	5.3	7.1	11.1	20.0	25.0	30.4	36.4	42.9	50.0

Starting Yield (t/a)	Reduction in Yield (t/a Annual Basis)										
	0.2	**0.4**	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**3.0**
	Minimum Percentage Price Improvement Required										
3	7.1	15.4	25.0	36.4	50.0	66.7	87.5				
4	5.3	11.1	17.6	25.0	33.3	42.9	53.8	66.7	81.8	100.0	
5	4.2	8.7	13.6	19.0	25.0	31.6	38.9	47.1	56.3	66.7	
6	3.4	7.1	11.1	15.4	20.0	25.0	30.4	36.4	42.9	50.0	100.0
7	2.9	6.1	9.4	12.9	16.7	20.7	25.0	29.6	34.6	40.0	75.0
8	2.6	5.3	8.1	11.1	14.3	17.6	21.2	25.0	29.0	33.3	60.0
9	2.3	4.7	7.1	9.8	12.5	15.4	18.4	21.6	25.0	28.6	50.0
10	2.0	4.2	6.4	8.7	11.1	13.6	16.3	19.0	22.0	25.0	42.9
11	1.9	3.8	5.8	7.8	10.0	12.2	14.6	17.0	19.6	22.2	37.5
12	1.7	3.4	5.3	7.1	9.1	11.1	13.2	15.4	17.6	20.0	33.3

CONCLUSION

No single strategy (e.g. cutting only for yield or only for quality) is always optimal due to fluctuation in the alfalfa hay market. Mixed strategies which assure a supply of both high and medium quality hay in response to market conditions may be reasonable to sustain profitable crop production over time. A flexible and diverse approach is important so that a grower can employ different management strategies to respond to the market conditions at the time. Most alfalfa growers have multiple fields requiring weeks to harvest a single cutting so it is feasible to employ different cutting management strategies on different fields. For example, in short growing season areas it may be advisable to take an extra cutting in mid October on some fields and taking the last cutting in early September on other fields. This lessens the risk of poor hay-making conditions at a given time and the risks of winter injury are less because not all fields were harvested using the same strategy. Similarly, alternating the number of cuttings taken from fields and from one year to the next may be a wise practice. In so doing, high quality alfalfa would be obtained from fields where an aggressive cutting frequency was used. Fewer cuttings would be taken from that field the following year, giving the plants a chance to "rest" to replenish carbohydrate root reserves. The same tactic can also be used within a season (a staggered cutting approach) alternating "quality" and "yield" cuttings to maximize quality while allowing for a recovery period. Planting a more dormant alfalfa variety on a portion of the fields is another approach to achieve high quality and increase flexibility.

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