ADJUSTING ALFALFA CUTTING SCHEDULES FOR ECONOMIC CONDITIONS

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ABSTRACT

The cutting schedule a grower imposes strongly impacts the overall profitability of an alfalfa operation due to its direct effect on yield and forage quality. The existence of a Yield/Quality Tradeoff has been has been well documented over the years in field trials and through grower experience. Within reason, fewer cuttings per season generally results in higher yield per season but at the expense of forage quality. However, determining the optimum cutting schedule is challenging due to ever-changing weather and price conditions. Using UC field research conducted in the Central Valley and the Intermountain area on cutting schedules, we used hay market data over the last 10 years to assess gross profitability for different cutting schedule strategies. The most profitable strategy depends on hay prices and more importantly on the price spread between the different hay quality categories. In general, it appears that over the past 10 years, the market largely did not adequately compensate alfalfa producers for the yield penalty they suffered to produce top quality hay. Gross returns were greater for strategies that produced higher yield (the 6-cut schedule in the Central Valley and the 3-cut schedule with a delayed second cutting in the Intermountain area). However, the marketability of high-yield but low-quality hay may be challenging. It is clear that high yield is more profitable in high price years and high quality is more important in low price years. We recommend a flexible and diverse approach which produces a combination of high yield (medium quality) and high quality hay, so that a grower can respond to market conditions in real time.

Key Words: alfalfa, *Medicago sativa*, yield, forage quality, profitability, cutting frequency

ECONOMIC IMPORTANCE OF THEYIELD-QUALITY TRADEOFF

Yield and forage quality are among the most, if not the most, important factors influencing the overall profitability of an alfalfa operation. Cutting frequency, or more precisely the maturity of the alfalfa when it is cut, determines forage quality and yield. This is under the grower's control and is the primary mechanism by which growers can respond to changing market conditions.

Yield and forage quality are inversely related. As the alfalfa plant matures, yield increases but forage quality decreases. This phenomenon is the scourge of the alfalfa producer and is a major source of frustration. It is often referred to as the Yield/Quality Tradeoff. It is possible to achieve high yield or high forage quality, but ordinarily not both. It is typicallydifficult to produce an alfalfa cutting of over 1.5 to 2 tons per acre and still meet "dairy quality" standards.

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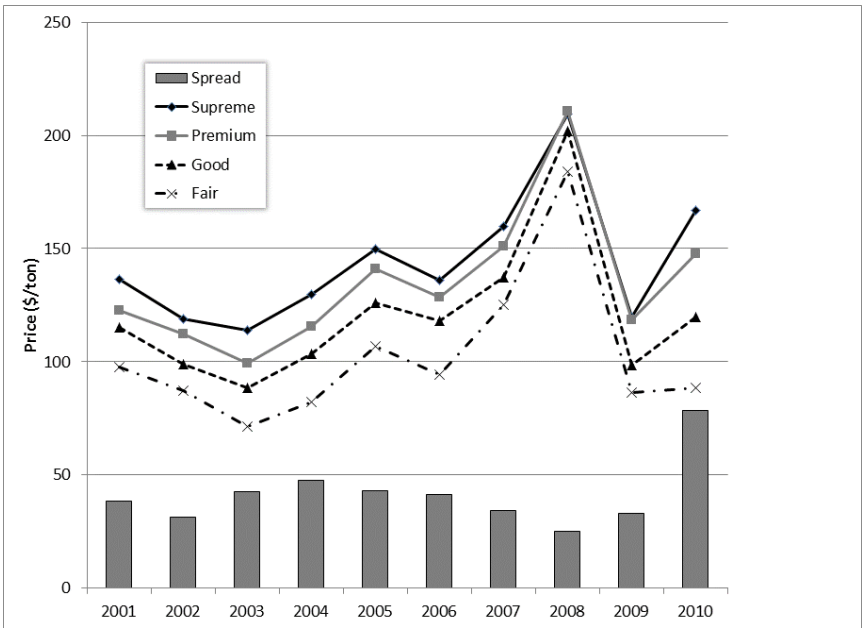
In some environments and under summer conditions, dairy quality alfalfa is often unachievable at reasonable yield levels.

Although genetic solutions have been proposed to this quandary, the Yield/Quality Tradeoff is largely unavoidable and presents a real challenge for the alfalfa producer. *Is it more profitable to aim for high quality or to sacrifice some quality for higher yield?* This can be a perplexing decision given the dynamic nature of the alfalfa market. Not only can the price vary considerably from year to year, but the price differential between hay quality grades fluctuates significantly from year to year as well (Figure 1). Generally speaking, the price premium for high quality hay is greater in low-price years than high-price years.



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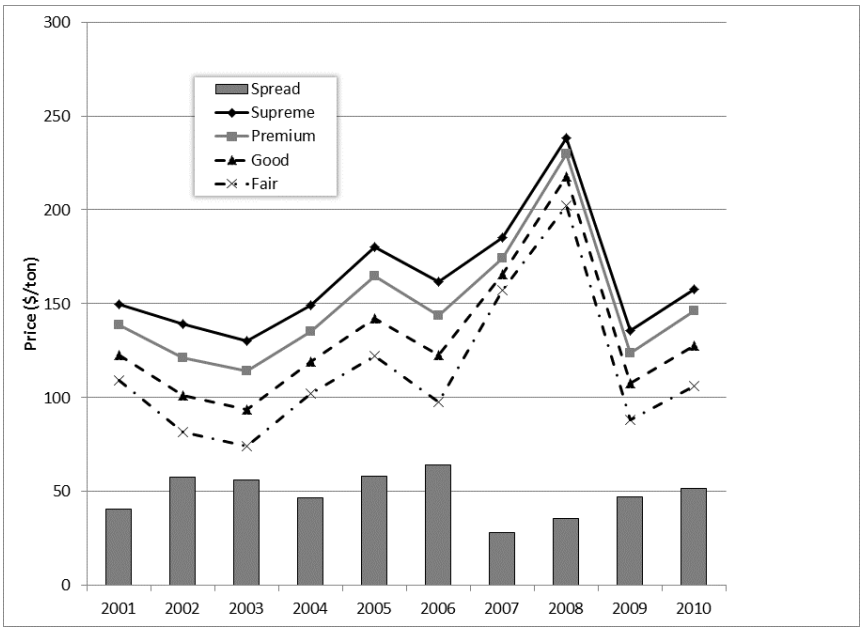

B.

Figure 1. Average annual alfalfa hay price in the Intermountain area (A) and the Central Valley (B) over the last 10 years (2001-1010). The price spread between *Supreme* and *Fair* quality alfalfa hay is shown in the bars. 2010 data is through September (Hay Market News data).

Research has been conducted in California and other states to quantify the rate of yield increase and quality decrease over time for different cuttings of the year. Knowing the rate of change in yield and quality can help with the decision of the appropriate cutting frequency to maximize profits. However, the shortcoming of using this approach is that the overall optimum cutting schedule for a season cannot be determined by evaluating a single cutting in isolation. Delaying a cutting to increase yield obviously cuts into the amount of growing season remaining for subsequent cuttings. Therefore, a preferred approach to assess which cutting schedule is most profitable is to examine the economic consequences of different cutting schedules over the entire season rather than evaluating a single cutting in isolation.

FIELD TRIALS

Central Valley. Research was conducted in the Central Valley and Intermountain areas of California to determine the effect of different cutting strategies on yield and quality. Six to eight cuttings are common in the Central Valley depending on the location in the valley and the weather conditions in a given year. The trial was conducted over three years from 2002-2004 in Davis, CA, where typically seven cuttings are made per year at around 28 day intervals for the majority of the season. This cutting frequency was compared with a more aggressive cutting schedule where the alfalfa was cut every 24 to 26 days for a total of 8 cutting per year, and compared with a less frequent cutting interval (32 to 33 day cutting interval) with six cuttings per year was evaluated as well.

Yield data for the Davis trial is presented in Figure 2. Fewer cuttings per year resulted in higher yield per cutting and higher total seasonal yield but lower forage quality. Total seasonal yield for the 6-cut, 7-cut and 8-cut schedules averaged over the 3 years of the study was 11.45, 9.92, and 9.32 tons per acre, respectively. However, the amount of supreme quality hay dropped from 59 percent to 29 percent to 16 percent when the number of cuttings was reduced from eight down to seven and six. These results further illustrate the existence of the Yield/Quality Tradeoff mentioned above.

Intermountain. Only three to four cuttings are made per year in the intermountain area due to the cooler weather and shorter growing season. We compared the yield and quality for three and four cut schedules in research trials at sites in the Klamath Basin (4,000 ft. elevation) and at a cooler location, Macdoel (4200 ft. elevation) in a two year study. Two variations of a three-cut system were evaluated as well. For one 3-cut schedule there were approximately equal intervals between the second and third cuttings. In the 3-cut schedule the timing of the second cutting was delayed a week to ten days to maximize production at that time of year.

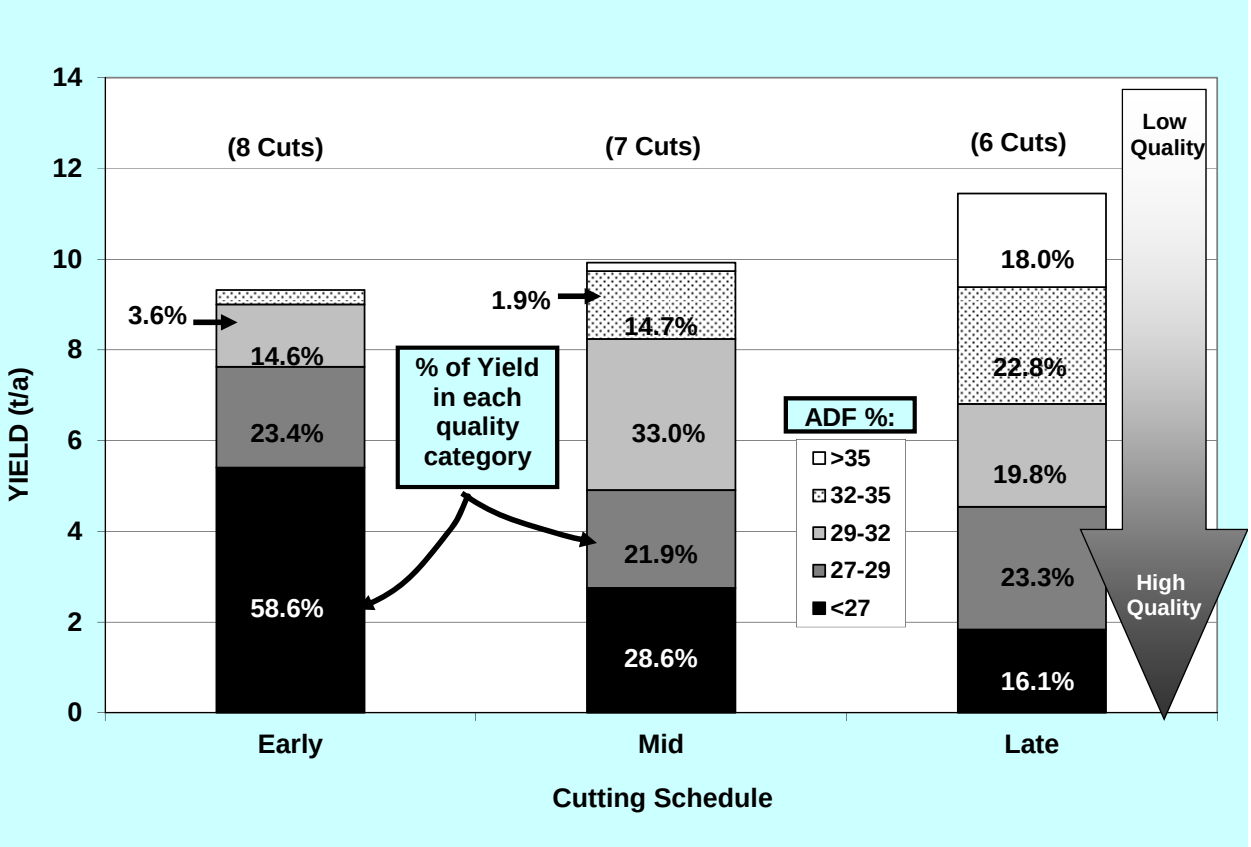

Figure 2. The effect of cutting schedule on yield and quality. Davis, CA (Average 2002–2004).

Total seasonal yield also decreased in the Intermountain area when alfalfa was cut more frequently. Four cuttings per year compared with three resulted in lower total seasonal yield at both intermountain locations compared with either of the two 3-cut strategies (Figures3 and 4). Total yield was higher at the Tulelake location due primarily to the warmer climate and superior soil (organic clay loam soil compared to a loamy sand). The 3-cut schedule with a delayed second cutting was the highest yielding treatment at both locations. Under intermountain growing conditions, a 4-cut schedule resulted in all *Supreme* quality hay for all the cuttings, whereas, the 3-cut schedules resulted in a mix of *Supreme*, *Premium* and *Good* hay. Delaying second cutting improved the quality of the third cut because the growing time was reduced and with the delay more of the growth period occurred when summer temperatures had cooled.

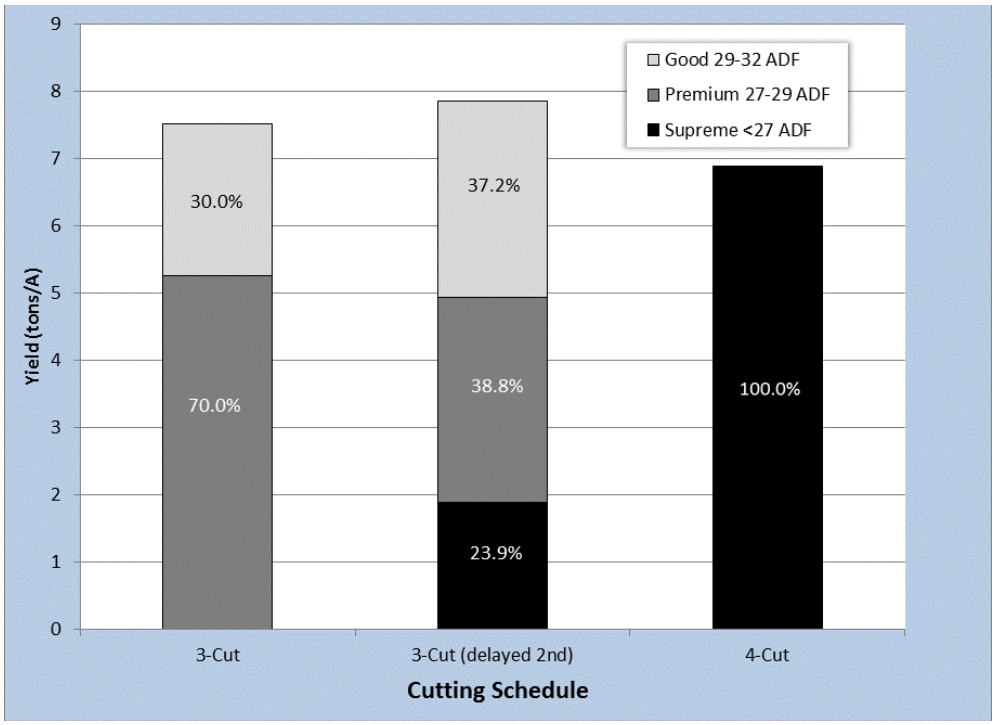

Figure 3. The effect of cutting schedule on yield and quality, Tulelake, CA Field Trial.

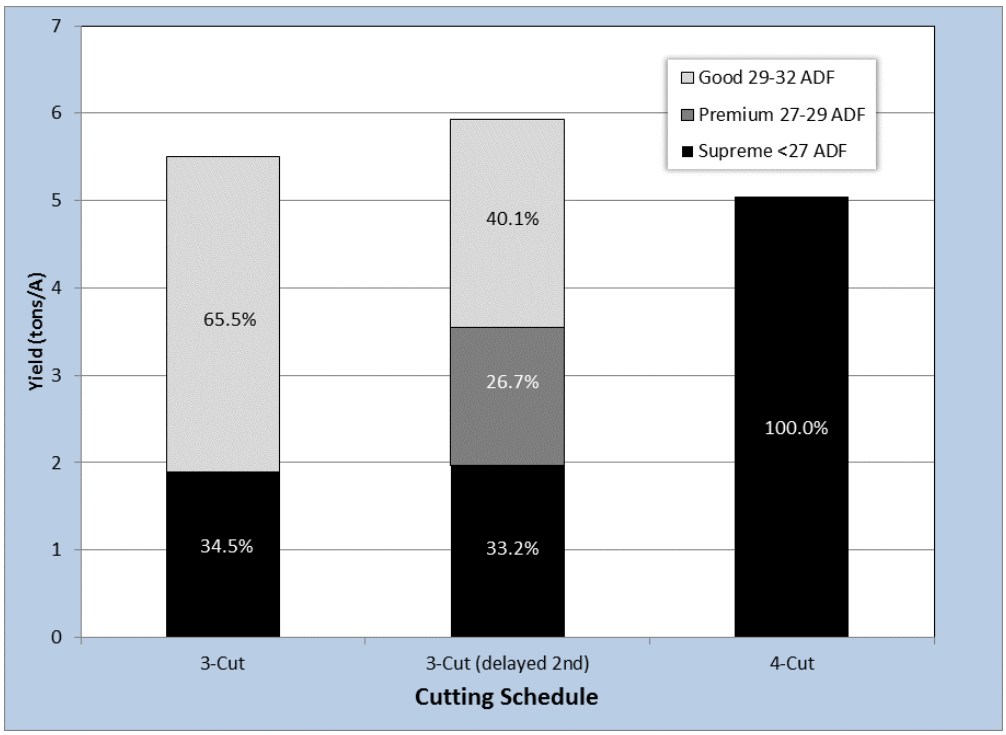

Figure 4. The effect of cutting schedule on yield and quality, Macdoel, CA Field Trial.

CUTTING SCHEDULE EFFECTS ON GROSS RETURNS

Gross returns per acre for each of the last ten years were calculated by multiplying the yield associated with each cutting schedule by the corresponding price for that hay-quality category. Categories were as per the guidelines developed by the USDA-Market News, and price data was collected for the last 10 years (2001-2010) using the USDA Agricultural Marketing Service Livestock & Grain Market News reports. Data for the Central Valley was pooled over several reporting districts to obtain an average net grower price representative for the Central Valley as a whole. The intermountain price data was classified in the USDA report as Northern Mountain net grower price.

Harvest Costs. Changing the number of cuttings per year obviously impacts harvest costs, which must be considered in the analysis of different cutting schedules. A study conducted by Blank *et al* indicated harvest costs were more influenced by the acreage harvested than by yield per acre. For the purposes of this evaluation, we assumed harvest costs in the Intermountain area to be $37.80 per acre per cutting for the higher yielding 3-cut schedule and $33.25 per acre for the 4-cut schedule. The study above indicated that Central Valley growers believed that overall yield had little effect on harvest costs in that area, perhaps because yield does not vary as much in the Central Valley as it does in the Intermountain area. For the purposes of this study, we assumed a harvest cost of $32 per acre for all harvest scenarios. These harvest cost values were subtracted from the calculated gross returns for each year to estimate partial gross returns (total returns minus harvest costs) for the different cutting schedule strategies.

Assumptions. There are some shortcomings or flaws to this kind of approach that should be kept in mind. We assigned a discrete price per ton based on the quality grade the alfalfa fell into. However, the actual price growers receive is more continuous and may not fall so neatly into the distinct hay quality categories. For example, alfalfa with an acid detergent fiber (ADF) value of 27.2% would in all likelihood receive a different price than alfalfa with an ADF value of 28.7 even though both hays would fall into the *Premium* designation. However, a price per increment of ADF does not accurately reflect market behavior either. Another difficulty in this analysis was assigning a price to higher ADF (lower TDN) hay. Hay that is not classified as “dairy quality” (*Premium or Supreme*) is typically not bought and sold based solely on its ADF value. Other physical characteristics such as color, “weediness”, rain damage, presence of mold, etc. become more important with these high-fiber hays. However, very coarse rank hay that may result from extremely long cutting intervals would likely bring a price below the price for *Fair* hay. There was very limited data available for alfalfa hay in the *Utility* category (ADF greater than 35 percent) so it was difficult to assign a price, especially knowing that in reality *Utility* quality hay is categorized using criteria other than fiber. To develop a discount for this very rank, high fiber hay, we used the dollar price difference between *Good* and *Fair* quality hay and divided it in half assuming as long as it was not weedy or moldy it would not incur the full discount.

CENTRAL VALLEY RESULTS

To our surprise, the 6-cut schedule resulted in the highest gross returns each of the ten years and averaged almost $150/acre higher than the 7- or 8-cut schedules. This illustrates the importance

of total seasonal yield to gross returns. It also lends credence to the argument put forth by many growers…that growers are not sufficiently compensated for quality. The value of the yield reduction incurred with frequent cutting quite often exceeds the price premium ascribed to high quality hay. However, it may be difficult to impossible to market the rank "stemmy" hay that results from a 6-cut schedule, especially in a low price year. So, in most cases growers must choose between the 7- or 8-cut schedules. Averaged over the 10 years, there was only a $3 per acre difference between the 7- and 8-cut schedules in gross returns (minus harvest costs) in favor of the 7-cut schedule. However, in 7 of the 10 years the 8-cut schedule was more profitable, though some years only marginally (Figure 6).

It is important to note that while the gross returns over the 10 years was almost identical for the 7- and 8- cut schedules, there was a fairly significant difference in profitability in individual years. This difference is not trivial. For example, in high price years with less monetary spread between top and bottom grades, seven cuttings was more profitable ($67 and $86 per acre increase in 2007 and 2008, respectively). However, in low price years where there was a wide spread between quality grades (i.e., 2002, 2003, and 2006) eight cuttings were more profitable than seven cuttings by nearly $40 per acre. This dollar amount multiplied over a thousand acres is a significant amount of money.

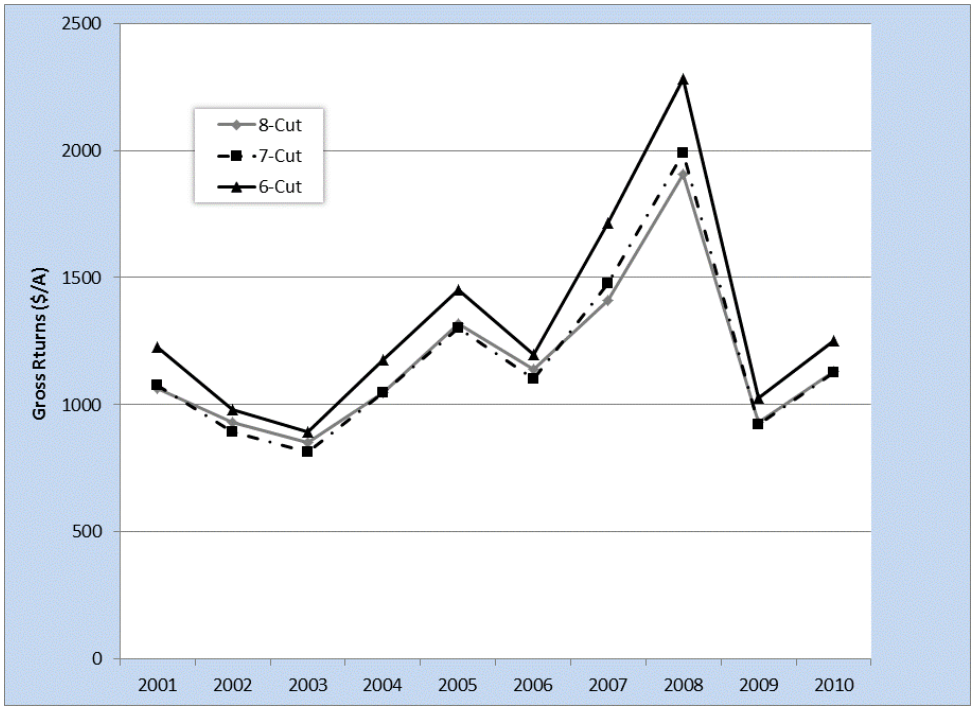

Figure 5. Gross returns calculated for the last 10 years for three cutting schedules (6, 7 and 8 cuttings per year) at Davis, CA. Data are average results from a three-year field study of early, medium, and long cutting schedules, and prices for individual years.

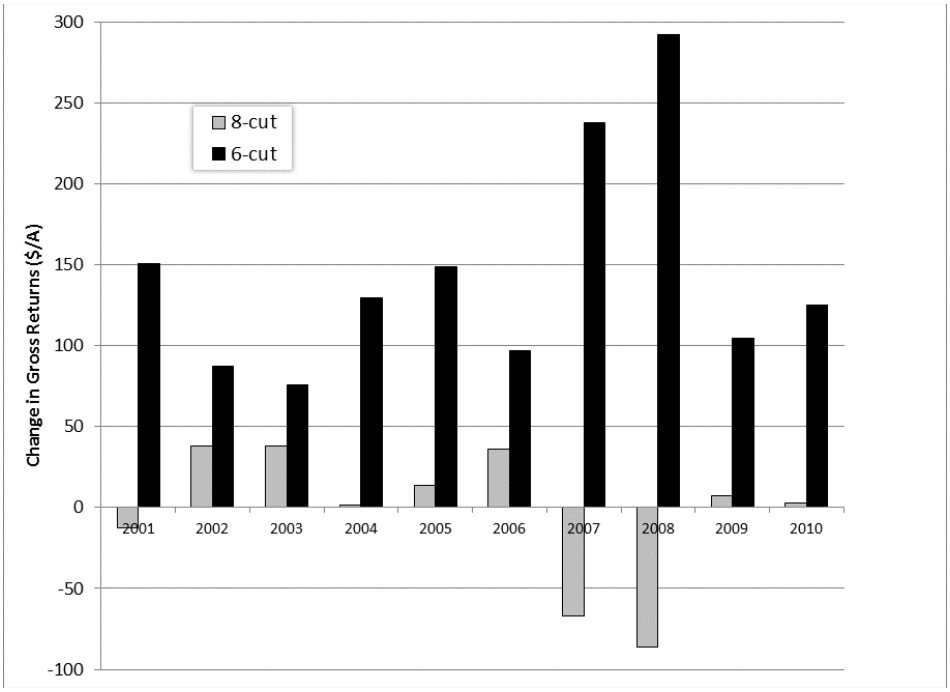

Figure 6. The differences in gross returns over the past 10 years for 6-cut and 8-cut schedules compared with a 7-cut schedule (the most popular schedule in the Central Valley) at Davis, CA. The baseline, or a zero value, is a 7-cut (28 day) schedule.

INTERMOUNTAIN RESULTS

The economics of the different cutting schedules was actually quite similar for the Butte Valley and Tulelake sites even though the overall yield was lower in Butte Valley (Figures 7 and 9). The 3-cut system with a delayed second cutting resulted in the highest returns each year. This approach had the highest production for the season, and delaying 2nd cutting improved the forage quality of the 3rdcut improving the price for that cutting without reducing yield too much. Whether the standard 3-cut schedule or the 4-cut schedule was more profitable depended on market conditions each year, but averaged over the 10 year time span they were almost identical. In an extremely high-price year like 2008, with little price spread between quality designations, the most profitable approach was clearly to lengthen the cutting interval and aim for high yield (Figures 8 and 10). A 4-cut schedule was $90 and $140 less profitable than the standard 3-cut system and the 3-cut delayed schedule was much better still. Like the Central Valley data, more frequent cutting (4 cuts) was more profitable than the standard 3-cut schedule in low price years with a large price differential between quality grades.

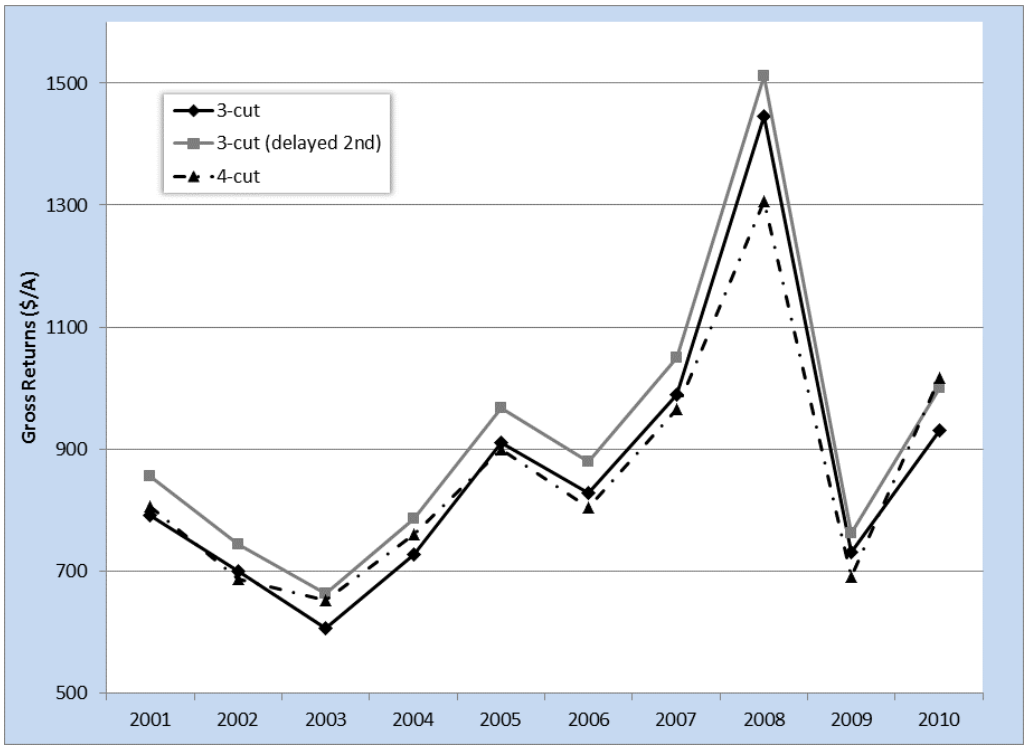

Figure 7. Gross returns calculated over the past 10 years for three cutting schedules (3 cuttings, 3 cuttings with a delayed 2nd cutting, and 4 cuttings per year) at Tulelake, CA

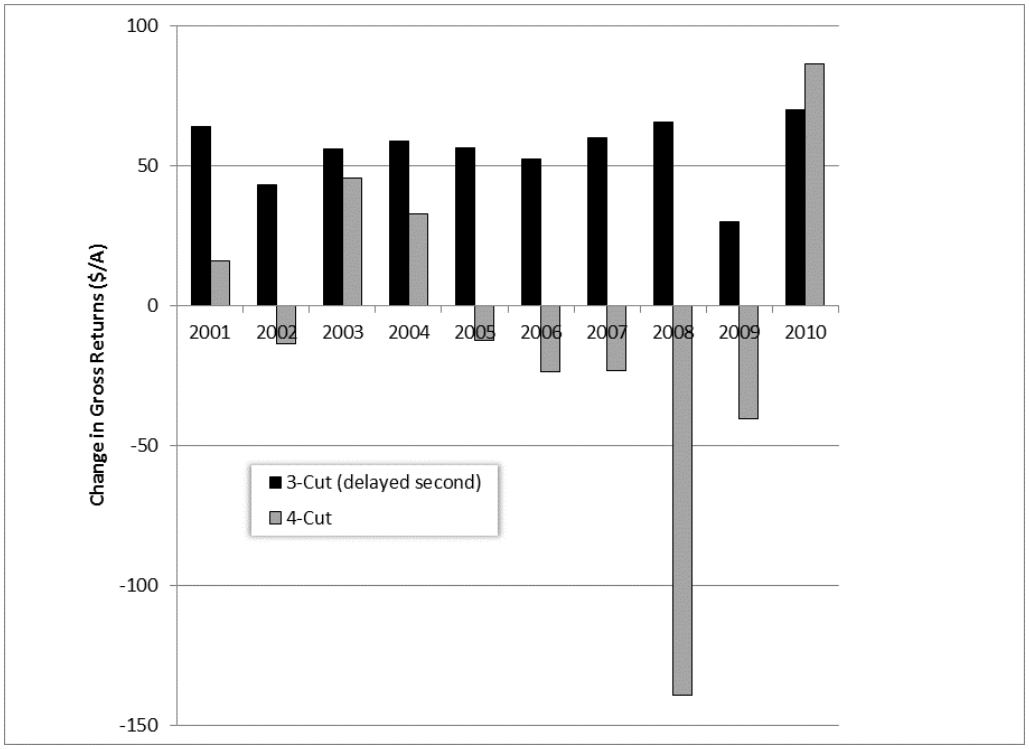

Figure 8. Difference in gross returns over the past 10 years for a 3-cut schedule with a delayed 2nd cutting and a 4-cut schedule compared with a standard 3-cut schedule (the most popular schedule in that region). The baseline, or zero value, is a standard 3-cut schedule. Tulelake, CA. Tulelake, CA

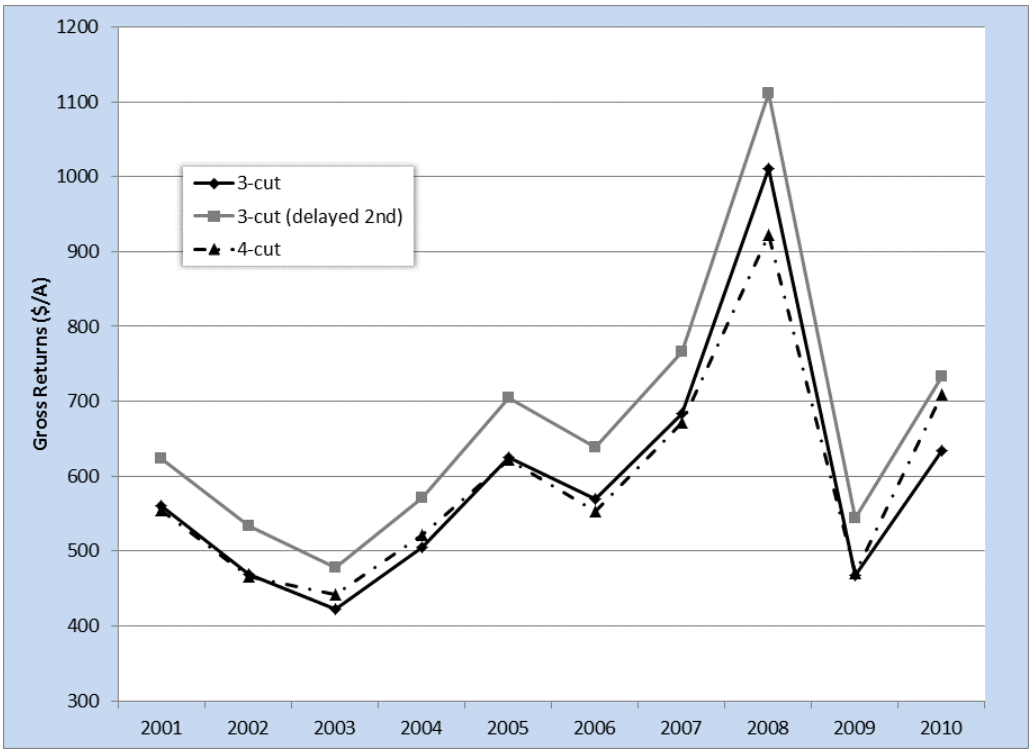

Figure 9. Gross returns calculated over the past 10 years for three cutting schedules (3 cuttings, 3 cuttings with a delayed 2nd cutting, and 4 cuttings per year) at Macdoel, CA

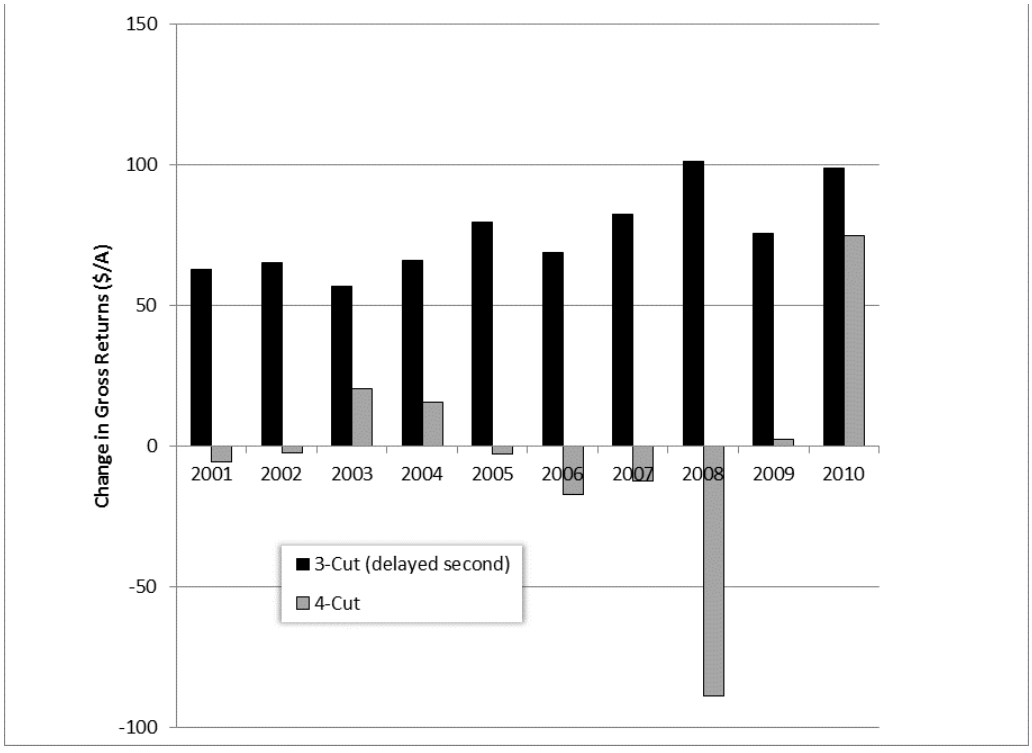

Figure 10. Difference in gross returns over the past 10 years for a 3-cut schedule with a delayed 2nd cutting and a 4-cut schedule compared with a standard 3-cut schedule (the most popular schedule in that region). The baseline, or zero value, is a standard 3-cut schedule. Macdoel, CA

DISCUSSION - LESSONS TO BE LEARNED

Determining the optimum cutting schedule is not a simple straightforward task, as demonstrated by this research and grower experience. Several factors must be kept in mind. The key factors which have been discussed are total seasonal yield, forage quality, and alfalfa price (primarily the price spread between hay quality categories), but other factors to consider are the marketability of the hay and the effect of cutting schedule on stand persistence. While higher-yielding cutting schedules almost always result in lower quality (a negative relationship), they also tend to improve stand longevity (a positive relationship, Figure 11). Longer cutting schedules provide the alfalfa more time to replenish carbohydrate root reserves and improve overall stand vigor and persistence.

The Primacy of Yield – But watch out! These data clearly show the importance of high yields (and cutting schedules which maximize yields) for profitability. There is ample evidence to show that more cuttings do not equate to more yield. In fact, the opposite is more often the case. If a grower can develop a strong market for mature high-fiber hay then longer cutting schedules, like the 6-cut schedule in the Central Valley, are clearly likely to be more profitable. However, for most growers, this type of alfalfa is difficult to market, particularly in low price years. This research assumes that a farmer can actually sell lower-quality hay – and in low price years this is often not the case. Growers are often forced to sacrifice profitability for high forage quality and use shorter cutting intervals, mainly to assure acceptance of their hay in the market.

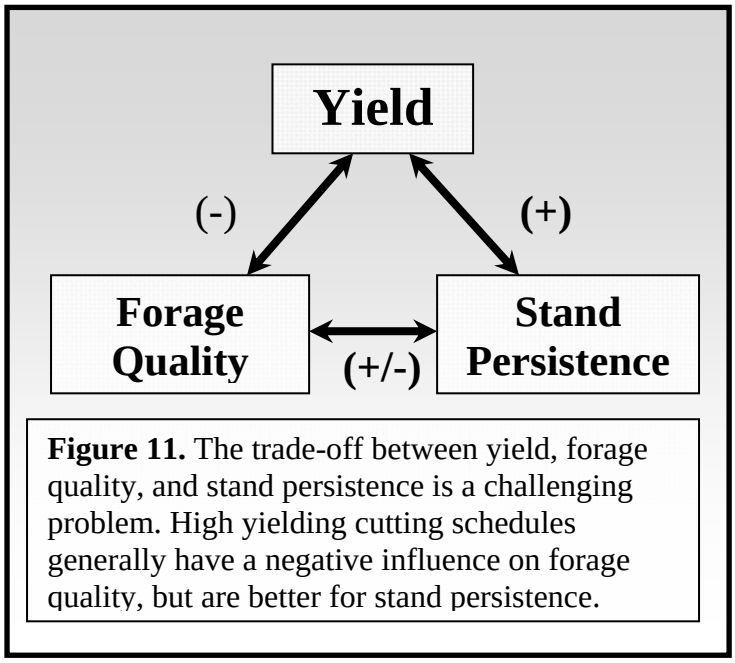

Figure 11. The trade-off between yield, forage quality, and stand persistence is a challenging problem. High yielding cutting schedules generally have a negative influence on forage quality, but are better for stand persistence.

Finessing Market Conditions. Among the more moderate cutting schedules (7 vs. 8 cuts in the Central Valley or a standard 3-cut schedule vs. a 4-cut schedule in the Intermountain area), the more profitable approach depends on market conditions. Simply put, in a low price year it is typically most profitable to go for yield and in a high price year go for quality. Ideally, the grower's cutting management schedule should be flexible enough to adjust to changing market conditions.

A Mixed Strategy. The best overall approach to cutting management is likely a mixed strategy, not purely cutting for yield or solely cutting for quality. What these data point to is that a 'one size fits all' (e.g. 28 day schedule) may <u>not</u> be the best economically—it too often results in compromised quality and compromised yield, and fails to maximize returns, compared with a more mixed strategy. Consider the season of the year and the ease of making dairy quality hay—high quality alfalfa is far easier to produce in spring and fall than in summer. Mixed strategies,

which assure a supply of both high and medium quality hay in response to market conditions, may be reasonable to sustain profitable alfalfa production over time. For example, the mixed strategy for the Intermountain area, where the timing of second cutting is delayed, is a logical approach. In the Central Valley, allowing one-to-three of the summer or late spring harvests to 'go long' to maximize yields and replenish root reserves makes sense, with the frequency depending upon the market conditions.

Most growers have multiple fields requiring weeks to harvest a single cutting so it is feasible to employ different cutting management strategies on different fields (see discussion of the 'staggered' cutting schedule approach, Orloff & Putnam, 2008) Alternating the number of cuttings taken from fields and from one year to the next may be a wise practice to allow plants more time to replenish root reserves.

CONCLUSION

Harvest scheduling for alfalfa is one of the most critical decisions facing alfalfa growers. This decision must be made multiple times over the life of stand. Despite its importance, many producers probably do not give this decision the consideration it deserves and cut on a calendar basis using a set schedule. However, our data suggest that a standard cutting schedule (e.g. a 28 day schedule) is not the best for optimum returns. Growers should consider a more sophisticated approach taking into consideration a wide array of factors including current and future market conditions, alternative marketing strategies, the physiology of the alfalfa plant as affected by cutting frequency, season of the year, and of course weather conditions.

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