REDUCING COSTS IN A DOWN YEAR: WHERE TO CUT AND WHERE NOT TO CUT?

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ABSTRACT

Alfalfa prices in 2016 were so low that they were reminiscent of decades ago. With prices this low, growers scramble to find ways to improve profitability, and where to cut costs is often the first consideration. However, most inputs directly impact yield or forage quality and cutting corners can reduce overall profitability. We conducted a grower survey to determine how growers cope with a depressed market and which practices they employ to improve returns. Here we suggest several options that should be considered, and several options that should NOT be considered to cut in a down year.

Key Words: alfalfa, *Medicago sativa*, economics, cutting schedule, fertilization, weed control, irrigation, stand establishment

INTRODUCTION

The 2016 alfalfa production season has been a challenging one to say the least—somewhat reminiscent of 2009, or of periods in the early 2000s. Alfalfa producers enjoyed record high prices in 2014, but they dropped significantly in 2015, and this year has been worse yet. Not only has the price been poor but movement has been sluggish, especially for "non-test" hay. Prices for this type of alfalfa hay (in the low $100s per ton) resemble prices of decades ago. The 2016 alfalfa production season has been one that many producers would prefer to forget.

One thing is for certain when prices are this low; growers search for ways to cut costs. A common approach, when faced with this situation, is to pull back on all inputs. However, this must be done selectively and with extreme caution because reducing inputs can lower yield and ultimately diminish profit or increase loss. In this paper, we examine which costs should be considered for cutting and which should not.

SELECTIVE COST CUTTING-WHAT DO GROWERS SAY?

To get a better idea of the strategies growers are currently employing to cope with a depressed hay market, we conducted a survey consisting of 12 questions and sent it to producers on the Alfalfa Symposium email list. A total of 151 responses were received from alfalfa producers (primarily from the western states of CA, OR, UT, AZ, ID and WA) and are summarized below. In addition to the summary of grower responses, we will provide suggestions based on our research and combined years of experience with alfalfa. Our objective is to evaluate some of the

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inputs involved in alfalfa production and make a general value judgment on where a savings could potentially be had and where not to cut corners.

SURVEY RESULTS

Our grower survey indicated most growers altered their farming practices somewhat in response to the down hay market this year (Figure 1). Only 21% of the respondents indicated that it was business as usual this year and that they didn't do anything special.

Purchase Less Equipment. The most common response to a depressed market was to purchase less equipment—42% of the survey participants selected this response. While not good news for equipment manufacturers, this is probably not too surprising. The cost of new tractors and hay-making equipment has risen to a point where it is difficult for alfalfa growers to justify a new purchase or to have the cash flow for a down payment in such a low price year. However, equipment prices are often lower in a year like 2016 so if a grower has the economic resources and plans to stay in the hay business long-term, an equipment purchase in a low price year may actually be a good idea.

Did Not Plant Any New Fields. One of the most popular reactions to a depressed market according to the survey was not to plant any new fields [32% of the growers indicated this was something they did (Figure 1)]. And, 26% of growers indicated they abandoned lower producing fields. This approach makes sense when a grower has the capability of switching to more profitable rotation crops. However, many alfalfa growers have few viable alternatives. On one hand, with questionable alfalfa prices for months to come and no clear upturn in sight, it is tempting to cut back on alfalfa acreage. For older fields, this makes sense, even so in an 'up' year. However, on the flip side, alfalfa acreage is much lower than it has been historically and if growers continue to abandon lower producing fields and plant fewer fields, now may be a good time for individual farming operations to plant alfalfa, especially if they plan to stay with alfalfa production long-term. As a perennial crop whose production typically peaks the second year, it is usually best to have a continual rotation schedule set up, with a new crop coming along. The last thing you want is for the price to turn around and only have older depleted stands left in production. Trying to time plantings so that peak production is in sync with high-price years is like trying to time the stock market. Good luck on that–if we knew definitely what will happen, we wouldn't be writing this article. But it does make sense to some degree to be a contrarian and plant when the prices take a nose dive like this.

CHANGING AGRONOMIC PRACTICES.

The second most popular responses for how growers dealt with the depressed market was that they *cut more frequently for quality* selected by 32% of the respondents. *Did not fertilize or reduced rates* was another popular response with 28% of the growers indicating they did this. Twenty-one percent of the growers surveyed indicated that they reduced their work force and did more of the work themselves—a difficult decision recognizing that most alfalfa farmers are probably overworked already. The least popular responses were *used less tillage for planting, planted a cheaper variety,* and *cut back on seeding rates*. Less than 5% of the respondents

selected any of these three management approaches to low alfalfa prices. These agronomic approaches to low prices will be discussed in detail in the sections that follow.

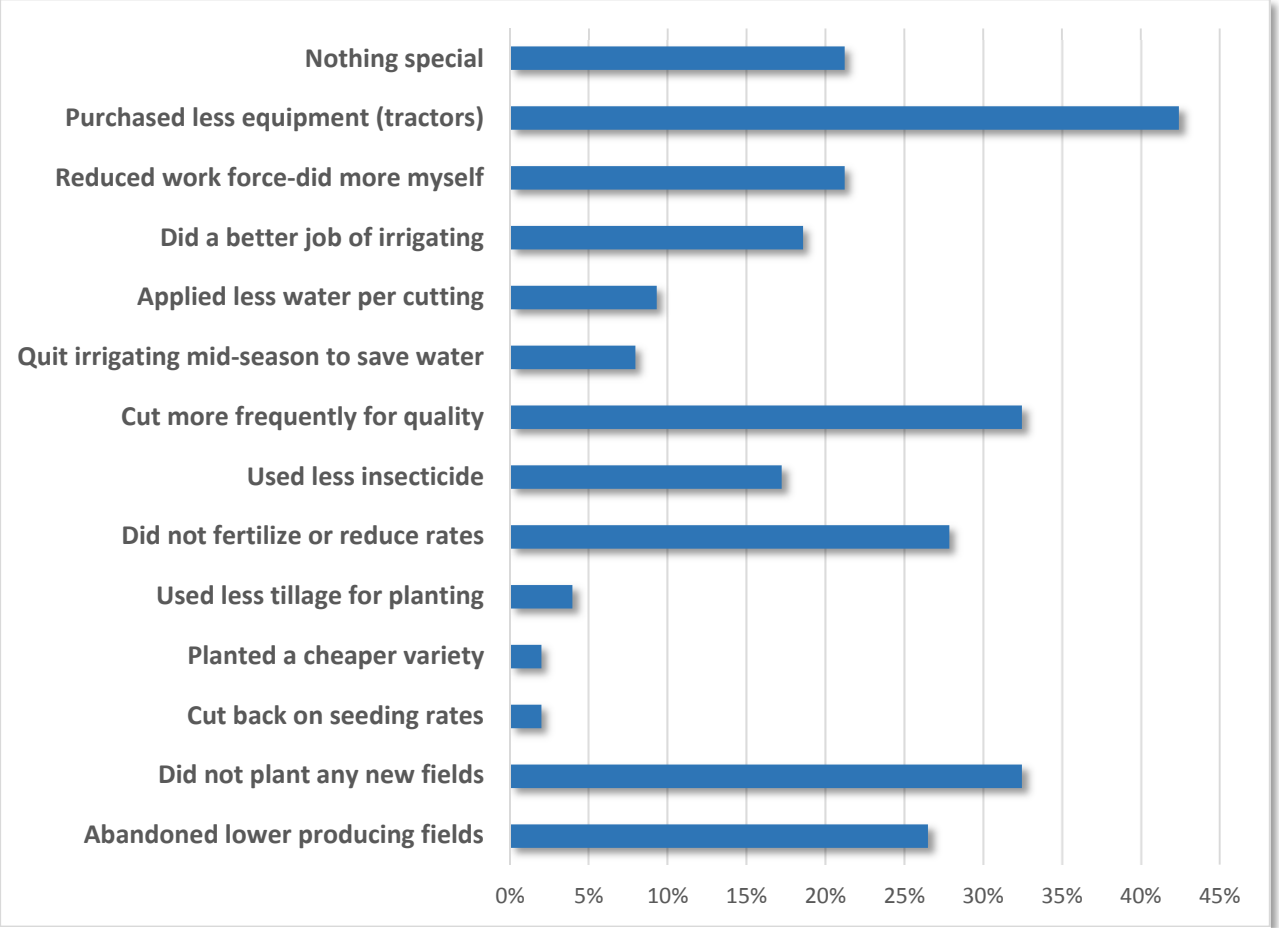

Figure 1. Overall survey results when alfalfa growers were asked to indicate what they did this year in response to the depressed alfalfa hay market. (151 respondents).

Selecting a More Profitable Cutting Schedule. Cutting more frequently to produce higher quality hay was the most popular production-oriented response. However, when specifically asked about their cutting schedule in a separate question, 40% of growers indicated that they did not change their cutting schedule this year in response to market conditions—many were probably already cutting frequently for higher quality.

This approach makes sense in a year like 2016. As is usually the case, there is a larger difference in price between *Premium* and *Supreme* quality alfalfa hay and the lower hay quality grades in a depressed hay market. This was true in spades this year. The price spread in California was often greater than $100 per ton this year between high and low quality categories, and sometimes *Supreme* quality hay was actually worth twice as much as *Fair* quality hay. This wasn't as pronounced in other Western states, but the same general trend applies.

The decision to "go for quality" and cut more frequently in a down year like this makes sense. The frequency at which alfalfa is cut affects forage quality more than any other management factor under producers' control. More frequent cutting results in higher forage quality but lower yield per cutting and oftentimes lower seasonal yield as well. However, with the premium that existed for high-test hay this year, the yield penalty was more than offset by higher prices. Not only has the price been much lower for mediocre quality hay, but sales have been sluggish as well, so many growers have been 'stuck' with medium or low quality hay.

Recommend Choosing a 'Mixed' Harvest Schedule Approach. Twenty three percent of the growers responded that they shortened the interval between cuttings, while 25 percent indicated that they did a combination of shorter and longer intervals. We advocate the combined approach. It is extremely difficult to produce "high-test" hay in mid-summer. During the hot temperatures of mid-summer, the internode length (distance between leaves on the stem) is typically greater resulting in a lower leaf:stem ratio; and the stems are lower in quality due more rapid accumulation of fiber. To produce "high-test" hay in mid-summer, alfalfa will likely need to be cut at an extremely short interval at the pre-bud growth stage. Not only is there a severe yield penalty for such early cutting, but this reduces the vigor of the alfalfa and its ability to recover for future cuttings. Therefore, we recommend aiming for high quality in spring and fall but giving the plants a "rest" and harvest at 10 percent bloom in the middle of the summer when producing top quality alfalfa is very difficult anyway. For areas with >6 cuts/year, growers should consider at least 2 cuttings be allowed to 'go late' to maximize yields and build root reserves and plant re-growth potential. It is NOT a good idea to try to make high quality at every cutting with short cutting schedules, since very frequent harvests result in stand loss, weeds, yield reduction, and often lower profitability.

FERTILIZATION

The most popular response after purchasing less equipment and not planting new fields was to not fertilize or use reduced rates of fertilizer. When asked more specifically about their fertilizer practices in a separate question, only 43 percent of growers said they had no change in fertilizer use (Figure 2). More growers said that they either quit fertilizing entirely, used reduced rates or tested more and scrutinized rates. Not fertilizing or cutting back for a year may be a viable option for growers that have fertilized most years and have maintained at least adequate fertility levels. This is especially true for growers who may be following a higher value crop that is heavily fertilized or for growers that have put on a set rate each year that may exceed crop needs.

Oftentimes, however, the growers that consider not fertilizing in low-price years are the ones that can least afford to do so. They are typically the ones that may have scrimped in the past and the fertility level of their field is low enough that fertilizer is important even in a low price year. *So…how do you know if you can afford to skip fertilizing or use reduced rates?*

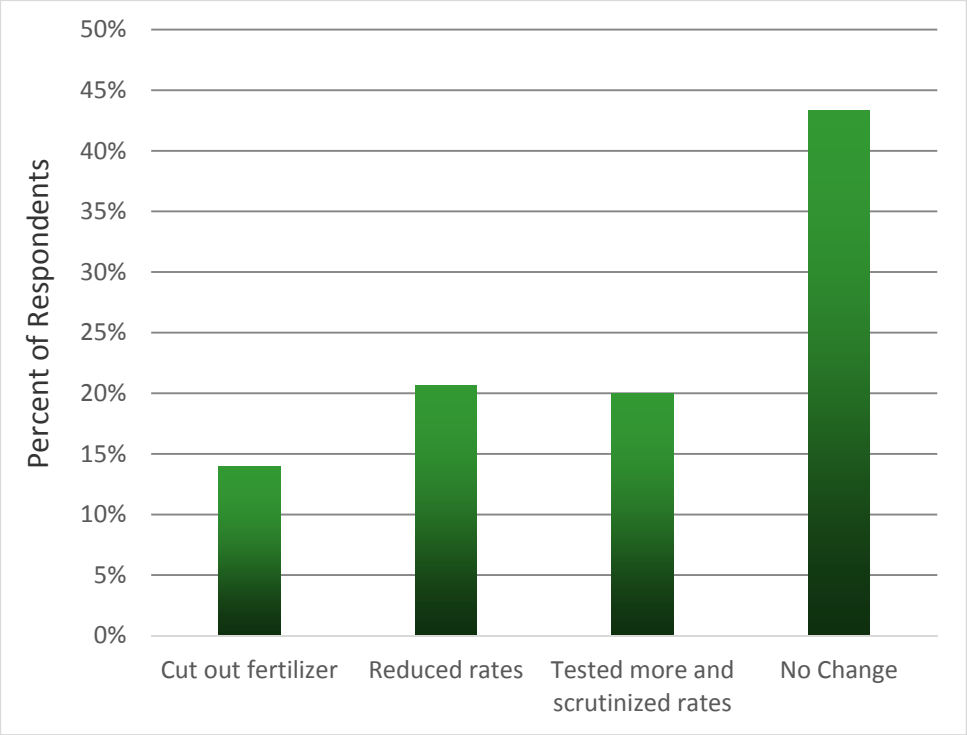

Figure 2. Survey responses when alfalfa growers were asked to indicate if their fertilizer practices change in a down year.

Recommend soil and tissue testing. Soil and/or plant tissue testing is the best way to know if you could afford to cut back on fertilizer. It may be tempting not to pay laboratory analytical fees when hay prices are low, but this would be a poor decision.

There are different philosophies or approaches to fertilization.

- Some growers fertilize using a recipe or "cookbook" approach. They apply a fixed amount of fertilizer, typically annually, that seems to have worked in the past. Eventually this approach results in over- or under-fertilization because the current fertility status of the field is not evaluated.
- Another approach is soil test level maintenance, commonly used in the Midwest. This is accomplished by applying the nutrients removed by crop harvest even when the soil test level for these nutrients may be sufficient.
- In the West, nutrients should only be applied when an economic yield increase is likely using critical nutrient levels. A "prescription" fertilizer program using soil analysis or plant tissue analysis is far more cost effective because fertilizer application rates are tailored to the actual needs of the field, avoiding the costs associated with over fertilization or lost yield due to under fertilization.

This last approach is the one we advocate, especially in a low-priced year.

Which nutrients are needed? Fortunately, alfalfa does not need the extensive fertilization program required for other crops. First, because it is a legume, there is <u>almost never</u> an economic yield increase from nitrogen fertilizer, especially in a low-price year. Second, it has an extensive root system that is able to take up nutrients that are often unavailable to other crops. Phosphorus is by far the most commonly deficient nutrient in alfalfa in the West and should be

the one alfalfa producers focus on. Sulfur is needed in some areas (mostly just the intermountain area), and plant tissue analysis is superior to soil analysis to detect a potential deficiency.

Potassium (K) deficiency is possible, but is rare and only occurs in small pockets of the state. Published university critical soil test levels (the level above which fertilizer is not considered necessary) for K vary widely from state to state and commercial laboratories may use higher numbers. UC values are about the lowest, meaning K fertilizer is not recommended unless the soil test value is lower (more deficient). Potassium fertilization is sometimes promoted, but remember deficiency is rare. Determine which critical K value is being used for the recommendation (the CA value is 80 ppm for the ammonium acetate extraction method). Usually K deficiency symptom, spots on the leaf margins, are visible in at least part of the field for there to be a consistent economical response.

Micronutrient deficiencies are almost unheard of. Sometimes Zn sufficiency guidelines are found in publications but the authors do not know of a Zn deficiency in alfalfa even when other rotation crops may be deficient. Therefore, micronutrient applications (except sometimes B and Mo in the intermountain area of CA) are not recommended or economical. Replicated fertilizer test strips are recommended before making whole-field applications of any nutrient that is rarely deficient in alfalfa.

Consider the economics of fertilizer applications. When considering a fertilizer application, the yield response should obviously at least justify the cost of the fertilizer application. The yield increase needed to cover the cost of the fertilizer (and the application) for varying application rates of 11-52-0 at three alfalfa hay prices is shown in Figure 3. As shown in the figure, a yield increase of at least 0.4 tons per acre is needed to cover the cost of a 100 pound per acre application of P_2O_5 at a hay price of $150 per ton. Can a yield increase of this magnitude be expected? The answer is definitely yes—yield increases in excess of a ton per acre are feasible. A soil test or plant tissue test is needed to predict whether a yield response of this magnitude is feasible.

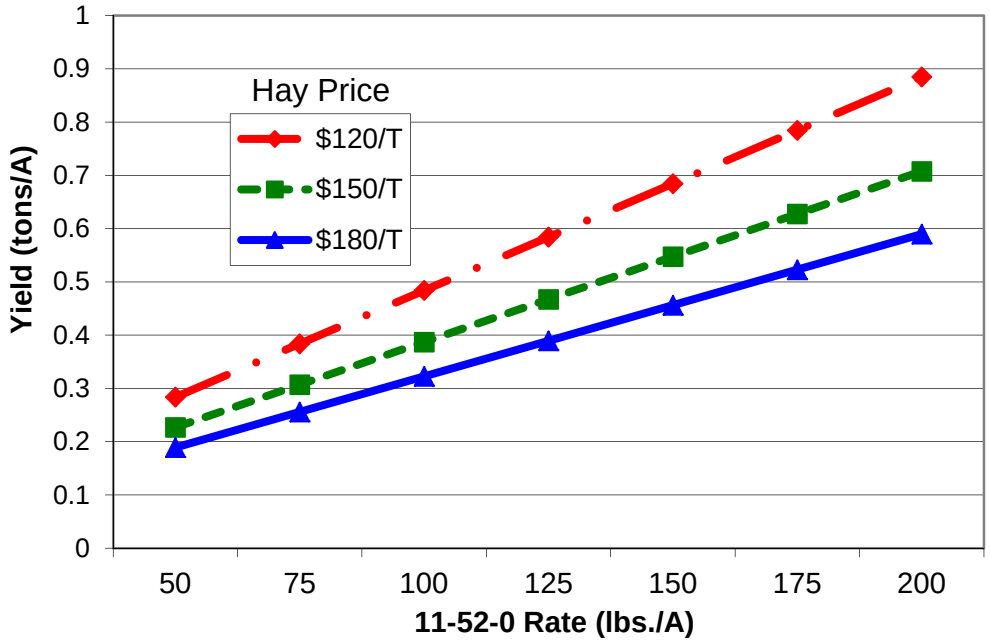

Figure 3. Total yield increase needed to cover the cost of an application of 11-52-0 at three hay price levels. (Assumes a cost of $500 per ton for 11-52-0 and an application cost of $10/A). If yield increases in a 'down year' are expected to be less than these amounts, one could consider postponing applications.

Consider reduced rates – but not if levels are low. The law of diminishing returns applies to fertilizer applications. In other words, the greatest response occurs with the initial increments of fertilizer and the rate of return declines as the soil fertility level approaches adequate to high levels (Figure 4). If a soil or tissue test indicates a field is clearly deficient, then a full application rate is justified. However if your soil test falls into the upper end of the marginal category, or the lower end of the adequate category, it may be feasible to apply a rate that is two-thirds or three-quarters of a typical rate when hay market conditions are poor. If the soil test shows adequate or high, it may be economical to skip fertilizer for a year. In a low-price year the point of maximum economic yield occurs at a lower fertilizer rate than a higher price year. A word of caution: after applying reduced rates successively for more than a year, the soil can become depleted and it may take high rates to return soil fertility to acceptable levels. Skipping a year or fertilizing with a lower rate can help reduce costs in the short term during low-priced years but is not a sustainable long-term solution.

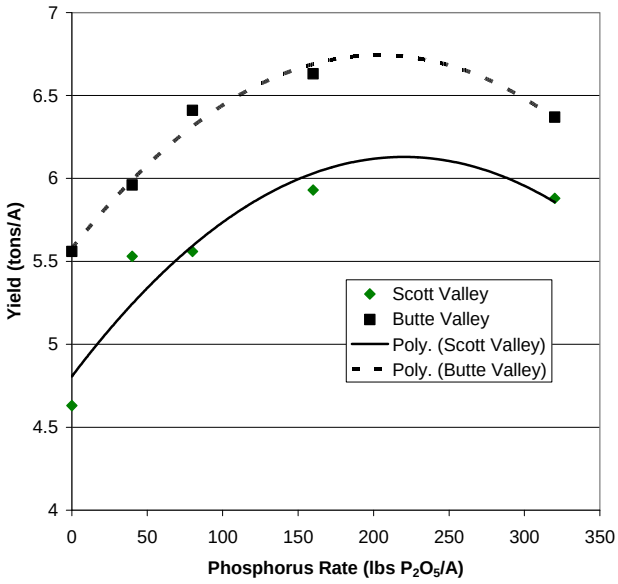

Figure 4. Annual yield response to applied phosphorus fertilizer at two locations in the Intermountain Region. Results show a typical fertilizer response curve. Comparing this curve to Figure 3, applications would still be economic at low prices if soil P levels are low.

Consider Site-specific fertilization. Most fields are not uniform. For example, in the intermountain area, it is not uncommon for there to be a two-fold difference in soil nutrient levels within a field. However, despite this variability, most growers rely on a single soil analysis to guide fertilization for an entire field, which virtually ensures that large portions of the field are over- and under-fertilized. Site specific management (SSM) involves applying a variable rate of fertilizer to account for differences in soil fertility levels across the field. This approach can lower fertilizer costs and improve yield because different areas of the field receive the appropriate rate of fertilizer rather than an average rate. The cost of grid soil sampling can be a deterrent in low-price years but an extensive grid may not be critical. Consider using a soil survey or observed soil difference in a field and sample those areas as zones. Then fertilize according to the soil test results for the different fertility-level zones.

Select the appropriate fertilizer. While always a wise practice, it is especially important to select the most cost-effective fertilizer materials in low-price years. Rather than just considering the cost per ton of the fertilizer, purchase fertilizer materials based on their cost per pound of the actual nutrient needed (often referred to as unit by growers). For example, when purchasing a phosphorus-containing fertilizer, select the fertilizer that is cheapest per pound of phosphate (P_2O_5). In most cases this will be 11-52-0. Some growers apply complete mixed fertilizers or even foliar fertilizers. These fertilizers are typically not cost effective. Research trials have not

shown an economic yield advantage with foliar fertilizers or special blends compared with granular fertilizers.

WEED CONTROL IN ESTABLISHED STANDS

Weed Management – Still vital in a down year. A majority of growers (66%) did not alter their weed control program despite low hay prices. A minority (21%) did indicate that they applied less herbicides, and 6% said they actually applied more. It appears that most growers recognize the importance of effective weed control in a down year. Whether weed control practices are economical obviously depends on the weed infestation level, the type of weeds present in a field, and the herbicides selecting and their cost. A heavily infested field, or a field with toxic or unpalatable weeds, will obviously be discounted to a greater degree. A rough estimate would be that alfalfa hay with light weed presence is discounted around $10 per ton, while heavy weed presence reduces the hay price by $30 per ton or more (personal communication Seth Hoyt). Hay infested with a toxic weed like common groundsel or a weed that causes feeding problems like hare barley (winter foxtail) will be discounted even more, and in a depressed market may be difficult to sell at any price.

Winter annual weed control. Ordinarily, doing without weed control in an established stand is not a viable option. Unfortunately, even if a grower has employed effective weed management strategies in the past, the weed seed bank is so immense that if weeds are left uncontrolled for even a single year, the weed infestation is sufficient to reduce the quality of the hay. The price penalty associated with weedy hay usually exceeds the cost of weed control. A winter dormant weed control treatment typically costs in the neighborhood of $25 to $45 per acre including the application depending on the herbicides used. First cutting yields are typically at least a ton and a half in many warmer growing season areas and 2 tons or greater in the Intermountain West. Hence, weed control is generally economical even in low price years. Not only is weedy hay significantly discounted, it may be extremely difficult to sell at all when hay sales are sluggish. Bottom line is clean hay pays in a down year. In addition, not controlling weeds replenishes the weed seed bank, causing problems for years to come.

Summer grass control. Summer grasses are a problem in many alfalfa production areas, especially the Central Valley and Low Desert of California. Hay market sources show that alfalfa hay with a little grass is often discounted $15 to $20 per ton within a hay grade. If the presence of grassy weeds causes the hay quality to drop a grade or two, the penalty would be much greater. Considering the fact that summer grasses can infest nearly all the summer and early fall cuttings (in excess of 5 tons per acre per year) in warmer growing season areas, an application of Prowl (pendimethalin) or Treflan (trifluralin) to control summer grasses is almost certainly economical, especially in older stands with higher weed pressure.

Weed control in seedling alfalfa. As a rule, weed control in seedling alfalfa should not be questioned and is more critical than weed control in established alfalfa. Cutting back on weed control practices in seedling alfalfa to cut costs is shortsighted if it results in a significantly reduced level of weed control. Weeds in a seedling stand can dramatically affect alfalfa stand density and the vigor of the young plants, diminishing the productivity of the field long-term. It is easy to underestimate the number of weeds in a seedling field. What initially appears like a

scattered weed here and there often transforms into a "weedy mess" come first cutting. Chemical weed control in seedling alfalfa is almost always economically justified.

***Opportunities to lower weed control costs*.** While eliminating chemical weed control entirely in a conventional hay operation most often does not make sense in a down hay price year, there still may be opportunities to reduce weed control costs. First, it is absolutely essential to know the weeds that will be present in your field to select the proper herbicide(s) and rate. Many producers apply winter dormant weed control treatments late in the season and are forced to use tank mixes of a soil residual herbicide (such as Velpar, Karmex, Sencor or Chateau) with Gramoxone (paraquat) to control large emerged weeds. Some growers could potentially save money on their weed control program by applying herbicides earlier in the season when the weeds are tiny or not yet emerged and use soil residual herbicides alone. However, this requires knowledge of the weeds present and their susceptibility to herbicides to determine if the soil residual herbicide alone can control the weeds. It still may be wise to tank mix with a contact herbicide (such as paraquat, Sharpen or Shark) but a lower rate can potentially be used if the field is treated early when emerged weeds are still small.

Most alfalfa producers rely on pest control advisors, crop consultants or agricultural chemical suppliers to develop their weed management program. These consultants select an herbicide program that gives them confidence they can achieve nearly perfect weed control because their reputation is on the line. It is conceivable that less expensive programs could be developed using lower rates, less expensive herbicides or fewer herbicides in the tank mix. I am sometimes amazed by the elaborate tank mixes and multiple applications that are used in some areas. In a down year, it may be feasible to cut back somewhat. There is some risk of not accomplishing 100% weed control when whittling down the rate or using less expensive herbicides. While this is potentially a way to reduce costs, growers must work with their weed management consultants and be willing to assume some of the risk if the weed control is less than perfect.

In Roundup Ready alfalfa fields, tank mixes with glyphosate are oftentimes used to ensure more complete weed control and to reduce the chances of herbicide resistant weeds or weed shifts. This is a highly recommended practice, at least sometime during the life of the stand. However, to reduce costs in a down year it may be fine to use glyphosate alone for a year, provided sound resistant management practices (herbicide rotation and tank mixes) have been used previously and/or will be used later in the stand life.

INSECT CONTROL

***Especially important to implement IPM in a down year*.** Most growers (53%) did not change their insect control program in response to poor alfalfa prices this year. However, 20% indicated they sprayed less and 22% indicated that they cut early in response to pest pressure. Only 3% actually indicated that they sprayed more. The decision to apply an insecticide in any year (high- or low-priced) should be based on integrated pest management (IPM) practices and economic thresholds. The term *economic threshold* implies that economic conditions are factored into the decision. In fact, the definition of an *economic threshold* or *treatment threshold* is the pest density at which a control measure is recommended to prevent a pest population from increasing further and causing economic loss.

In theory, an economic threshold should be continually revised to account for new varieties, new management practices, and variation in both commodity price and the cost of insecticides or other control measures, and the efficacy of the chosen control measure. However, our current thresholds in alfalfa are too simple (our opinion) and should be updated. A threshold should be dynamic value rather than a static number and account for annual variations in the alfalfa market, insecticide price, as well as current and predicted weather conditions. The current economic threshold for alfalfa weevil of 20 larvae per sweep was developed in the early 1970's and has remained fixed since it was first published over 40 years ago. Similarly, economic threshold values for aphid species were also developed in the 1970's, before varietal resistance was as integrated into most alfalfa varieties as it is today. In addition, current aphid thresholds are based on the number of aphids per stem, a practice that is rarely done by Pest Control Advisors (PCA's) or growers. A better threshold for when blue alfalfa aphid and pea aphid co-occur (which is quite common) is also needed.

'Tweaking Insect Thresholds' The lack of reliable up-to-date thresholds that take into account changing economic conditions has left growers and Pest Control Advisors somewhat on their own to develop thresholds for changing economic and environmental conditions. While current thresholds have their limitations as mentioned above, they do provide a baseline that can be "tweaked" or modified depending on the type of year. Many Pest Control Advisors feel the alfalfa weevil threshold should be lower than 20 larvae per sweep, and as mentioned above, most don't use the stem count sampling methods for aphids. Therefore, some fields are treated prematurely when these pests are merely present rather than when the populations actually reach potentially economically damaging levels. Growers should inquire about the threshold being used and make sure standard monitoring procedures are used rather than merely treating when the pest is present or as a "preventative" measure. Treating prematurely can often make subsequent pest pressure worse by killing beneficial insects that could have kept pest populations in check.

Even in poor price years, an insecticide application is often warranted, but only when pest populations reach or exceed an economic threshold. Generic forms of many insecticides are available—which is an option to reduce the cost of treatment in poor price years. It does not take much of a yield increase to justify the cost of many insecticide treatments even in a low price year. Sometimes the yield increase needed is only one tenth of a ton per acre and the potential yield decrease caused by some insects far exceeds that value.

Another option to carefully consider in low-price years is to cut the crop early instead of applying an insecticide (a practice 22% of the growers indicated they did). The viability of this approach depends on the growth stage of the alfalfa and how much time is left until the desired cutting date. Ordinarily, if the pest population is above the threshold and there are at least two weeks before cutting, an insecticide treatment is advisable. Another factor to keep in mind with early cutting is that while cutting controls most pests, this is not always the case. Alfalfa weevil, a common pest in California and other Western states, can sometimes survive a cutting and congregate under the windrow causing serious damage—something we observed in the Intermountain Region and in the Central Valley this year.

IRRIGATION

There is no question irrigation is one of the most critical inputs for alfalfa production in the West. Growers recognize this. In this low-price year, 53% of the growers surveyed did not change their irrigation practices (Figure 5), and of those who did, hay prices were not the primary cause (35% changed due to water supply, whereas only 12% changed due to low prices). When specifically asked about how they irrigated in this low-priced year, the most popular answers were that they upgraded irrigation equipment and management and irrigated more carefully using evapotranspiration (ET) data and soil moisture sensors. An equal percentage of growers (16%) either irrigated less per cutting or quit irrigating some fields partway through the season. Only 7% quit irrigating some fields entirely.

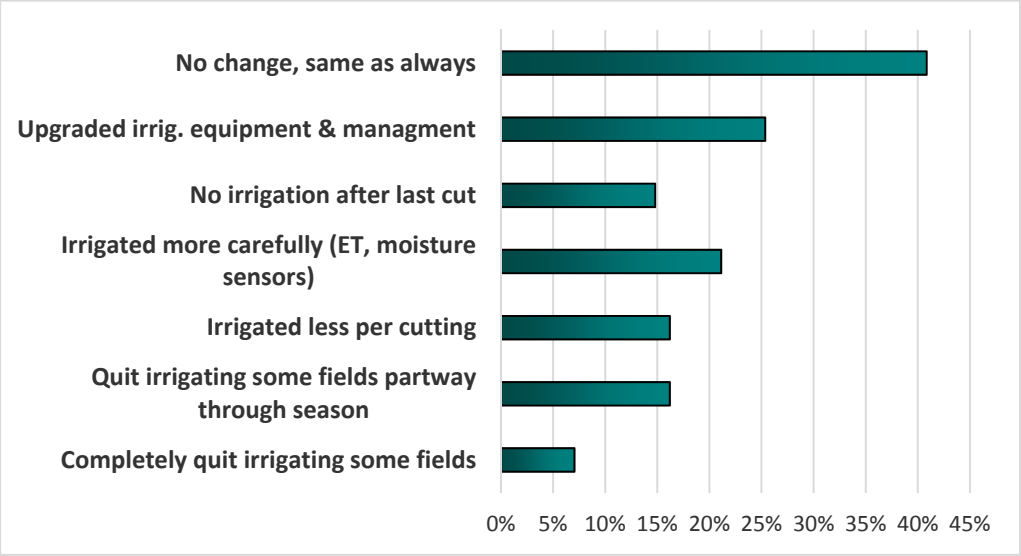

Figure 5. Survey responses to the question how did your irrigation practices change in response to the depressed alfalfa hay market.

Deficit Irrigation Strategies. There are two basic approaches to deficit irrigation of alfalfa. One involves applying somewhat less than full ET for each cutting thereby stressing the crop through the season (Starvation Diet). The other approach involves ceasing irrigation partway through the season and forgoing a cutting or several cuttings thereafter. Ordinarily, these practices are not considered economical but when prices are as low as they have been this year, this question deserves another look.

Reduced irrigation amount. Alfalfa yield increases in a linear fashion as evapotranspiration (ET) increases. The relationship between ET and yield varies among environments but the relationship is generally linear (Figure 6), meaning that yield increases with every increment of ET up to full ET for the crop. After that point, yield remains constant. Alfalfa is an herbaceous crop with rapid growth characteristics, and growth can be rapidly reduced when the plant is stressed for water.

However, that doesn't mean that every additional drop of irrigation water results in higher yield. Unlike the relationship between yield and ET, the relationship between yield and **applied** water is not linear once the application amount approaches full ET. Because irrigation systems are not totally uniform, some portions of the field typically receive more than what is needed and other areas may receive less water than the ET requirement.

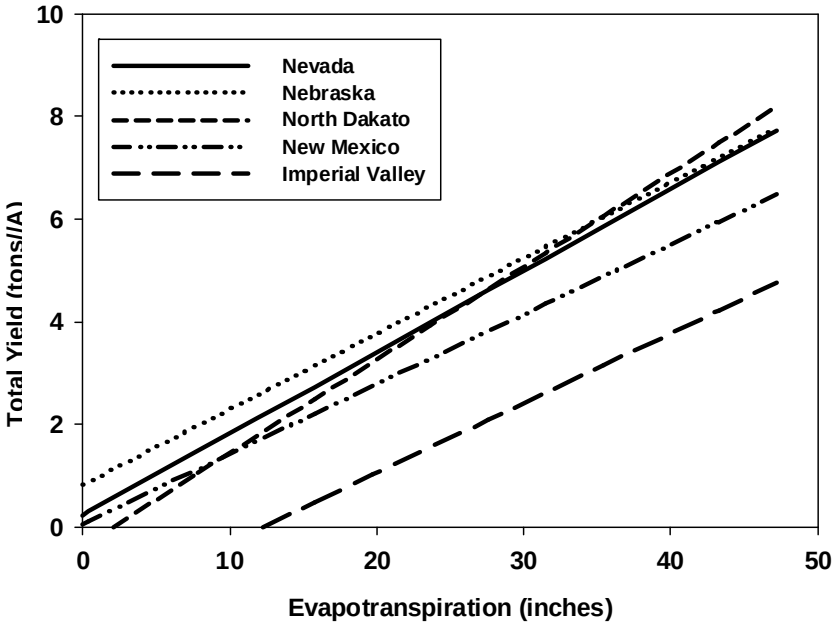

Figure 6. Relationship between alfalfa yield (tons/A per year) and evapotranspiration (ET in inches) for various locations in the West. (Hanson, 2007).

When alfalfa prices are high and/or water is inexpensive, it is economical to apply enough water so that very little to none of the field is under-irrigated, even though some areas of the field will be over-irrigated. However, when the alfalfa price is low and/or water price is high, it may be economical in some situations to allow parts of the field to receive less than the full ET requirement. Determining exactly what that quantity is can be difficult. The main point is that severe deficit irrigation (where no area of the field receives full ET) is not economical because the yield penalty is too great.

Partial-season irrigation cutoff. Alfalfa yield in most regions is lower the second half of the growing season compared with the first. In addition, all or nearly all of the crop's water needs must be met with irrigation during the summer months because there is very little rainfall during the second half of the growing season. So when water supplied are insufficient or uneconomical, it is usually preferable to use this partial-season approach where the water is withdrawn part way through the season rather than stressing the crop throughout the season with a starvation diet approach. Alfalfa enters a drought induced dormancy and normally fully recovers once re-watered by irrigation or rainfall. Whether partial-season irrigation is economical or not obviously depends on the alfalfa price and water costs. However, ordinarily the alfalfa price is not so low and water costs so high that this practice is economically justified. Usually partial-season irrigation is done out of necessity because water supplies are inadequate. However, the economics might be different if the water not used for irrigation was sold for another use, or used to irrigate a more profitable higher value crop.

Partial-season irrigations have been widely practiced by alfalfa growers in many areas as a result of the 20013-20016 drought, and most of these fields have exhibited full recovery after a 1-3 month drought period.

Irrigation after the last cutting... Is it needed? Fifteen percent of the growers surveyed indicated they didn't irrigate after the final cutting in response to low prices (growers were only asked to select this option if they normally do). Whether irrigation after the final cutting is necessary is an interesting question in itself, regardless of hay prices. The authors have conducted numerous irrigation cutoff studies and alfalfa yield has bounced back the following year to the same level as areas that were fully irrigated. And, this is with an earlier irrigation cutoff than just not irrigating after the last cutting. This may not be true for all alfalfa production regions or soil types and the need for irrigation after the last cutting in geographically diverse areas deserves further investigation. The authors believe that in most areas it is unnecessary. The key is to start off the following season with a full soil profile. If winter rains in an area are insufficient to refill the profile then this should be done with spring irrigations. However, if it is difficult to refill the profile in the spring due to water availability or freezing temperatures, irrigation after the last cutting in the fall may be beneficial. However, in most areas where the soil profile is filled with rain or spring irrigation, irrigating after the last cutting is most likely not needed and is a potential area for cost savings.

Higher level of irrigation management. Because of its impact on yield, proper irrigation management is essential in a low-priced year. It is important to know how much water your irrigation system applies, identify the amount needed to satisfy ET and account for inefficiencies in the irrigation system, and apply only that amount and not more. This is done through soil moisture monitoring and/or weather-based irrigation scheduling. Improving irrigation system efficiency can also improve profits by reducing the amount of applied water needed to ensure that at least most of the field is receiving enough water to satisfy peak ET.

REDUCING COSTS DURING ESTABLISHMENT QUESTIONABLE – BUT THERE ARE AREAS TO CONSIDER

It was pleasing to see that cutting back on inputs when establishing a new stand ranked the lowest of all the cost cutting measures (Figure 1). When specifically asked about new seedings, it appears growers just didn't plant or planted fewer fields, but did not cut back on most inputs (Figure 7). Growers seem to recognize the shortsightedness of scrimping on inputs that may detract from their ability to establish dense vigorous long-lived alfalfa stand.

Herbicide use. As pointed out above, near complete weed control is beneficial for seedling alfalfa and the growers surveyed in general did not cut the rate or use less expensive herbicides.

Less fertilizer. This was the most popular input to reduce. This may be possible in some cases, but totally depends on soil fertility levels, which can only be adequately evaluated with a pre-plant soil analysis. Phosphorus is important for seedling root development and this is the only time when P can be incorporated.

Less tillage. No-till or minimum-till may be effective for other crops, but in California cropping systems, tillage is important for alfalfa seedings, especially when a soil has restricted or compacted layers. Also, since alfalfa is such a small seed, a firm smooth packed seedbed is essential. However, no-till seeding has been demonstrated to work under some conditions.

Cheaper seed. As has been pointed out repeatedly at this conference, seed cost is a minor component of overall production costs. Improved alfalfa varieties are worth hundreds of dollars more per acre in potential yield compared with older, unimproved seed, or seed of questionable origin. Remember that it only takes less than 1 tenth of a ton yield increase each year to pay for

even a $2/pound increased seed price, an amount that is easily surpassed by many improved lines.

Reduced seeding rate. While this was not a popular cost cutting measure, there may be a way to cut costs for growers using seeding rates over 25 pounds per acre. Most researchers feel a proper seedbed is more important than seeding rate. A seeding rate of 10 to 15 pounds of pure live seed is probably sufficient, especially when seeding with the press wheels found on some of the newer drills and more precise seeding depth. However, be sure to pay particular attention to depth control and soil preparation to assure high rates of stand success.

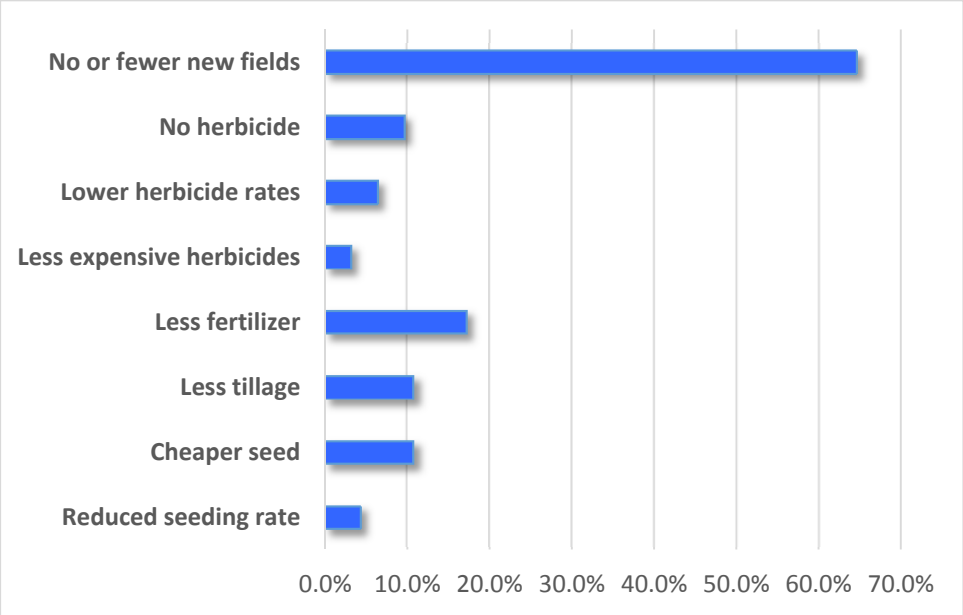

Figure 7. Survey results regarding potential cost cutting measures used for new alfalfa seedings in 2015-16.

MAXIMIZING ECONOMIC RETURNS ON INPUTS

Figure 8 indicates a generalized response to an input which impacts yield. It is important to examine each farm input to determine whether one is on the lower end of that curve (which maximizes return per unit input), rather than in the marginal range (which gives incremental or marginal returns per unit). It's especially important to avoid inputs that on the excess side of the curve.

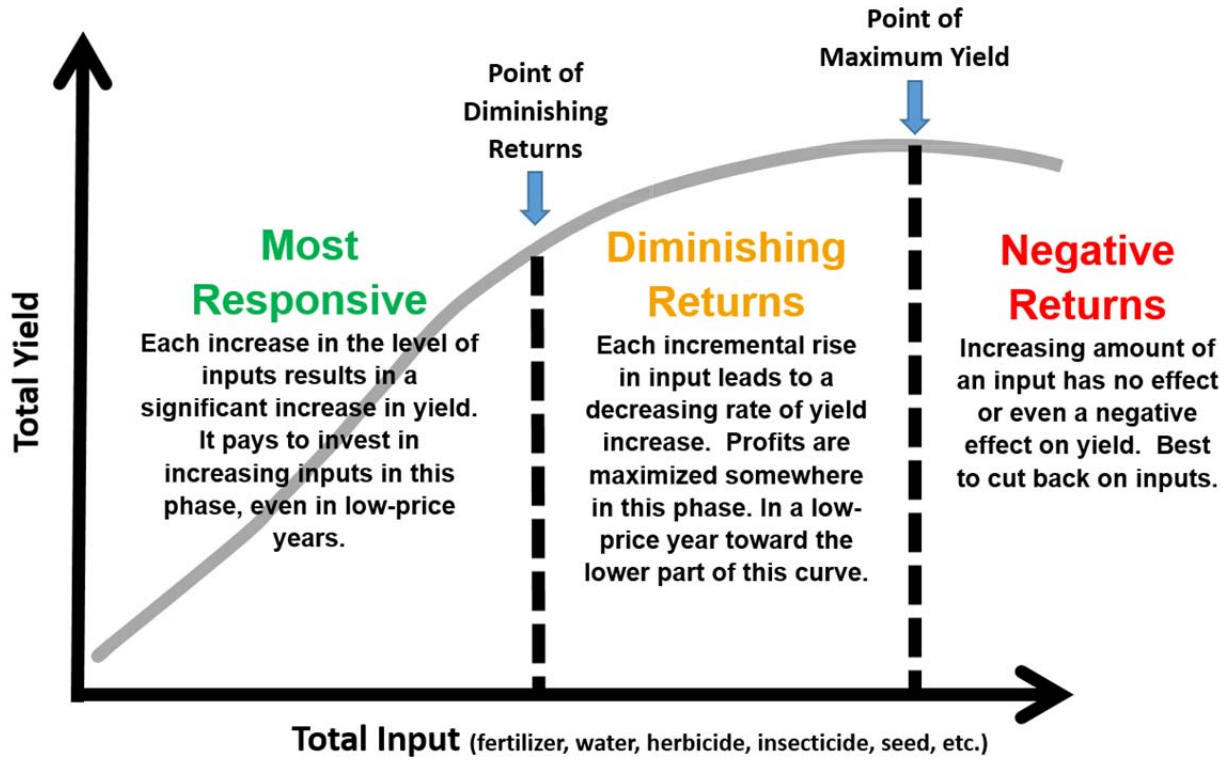

Figure 8. The concept of a diminishing return curve can be used to evaluate the profitability of each input. It pays to invest in increasing inputs on the steep part of the curve (left), while it is best to cut back on inputs on the far right of the curve where yield has reached a plateau. Greatest profitability is in center portion of the curve. In a low-price year the most profitable point is further down the curve than in an average or high-price year.

SUMMARY

There is no sure-fire universal recommendation for how to cut costs without reducing overall profitability, but it is clear that cost-cutting should be selective and not indiscriminate. The answer is different for every farm. Maximum yield and maximum economic yield are usually different. Maximum economic yield in agriculture often occurs at 90 to 95 percent of maximum yield, and in a low price year, this percentage is likely lower. In addition, the point of maximum profitability varies from year to year depending on alfalfa price and the cost of inputs. Careful scrutiny of each input is more important in a depressed alfalfa market than when prices are higher. Growers should carefully analyze all inputs and farming practices to ascertain where they fall on the diminishing return curve in Figure 8. The cost-cutting measures we discussed are summarized in Table 1 below including the potential downside and rationale for each measure.

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Table 1. Potential cost-cutting measures to consider in a low-price year.

Measure	Downside	Comments/Recommendations
Postponing new equipment purchases to lower debt burden	May increase maintenance cost, and bargains may be found in a down year.	Postponing large purchases may be a good way to postpone costs in a down year, but a long-term view should be taken and some equipment may reduce other costs such as labor.
Having fewer employees	Could burn oneself out or loose good people.	This is one obvious way to cut costs, but good employees are quite valuable, so long-term impacts should be considered, including morale.
Eliminating poor-performing, weedy fields	Reduces overall volume of production. Other options may not be good.	Good move, poor-performing fields are economically questionable even in an 'up year' and produce an over-supply of poor quality hay. A fallow year may be warranted?
Postponing new plantings	New fields are often more productive. Consider the long-term future of the farm and need for good fields in 2-3 years.	This is a reasonable step, but planting in a 'down year' can lead to higher profits when prices recover. Betting on a new crop in a down year may be the right move, but it's hard to say.
Purchase cheaper seed	Could be planting a much lower yielding variety.	Planting the cheapest seed is never recommended. Plant seed with the highest performance promise-clearly advantageous economically. Examine performance data such as the UC variety trial data.

Reduce seeding rate	Could result in a less-than perfect stand.	This is one area that could be considered since growers often plant >25 lbs/acre which isn't often warranted. Pay particular attention to other establishment methods, especially soil prep and seeding depth and reduce seeding rates to 12-18 lb/A and be careful how you plant.
Reduced till or no-till	Compacted layers not fractured and lack of land levelling.	While reduced or minimum till is certainly feasible on some soils into wheat or other stubble, lack of deep tillage on some soils could hamper growth for years. Consider long-term compaction. Very site-specific, and not generally recommended for check-flood fields.
Reduced herbicide during establishment	May weaken stands for years to come.	Recommend vigorous weed management during stand establishment-don't skimp on seedling weed management. Can consider early cutting to manage weeds, but early cutting may also affect long-term stands.
Reduced herbicide in established fields	Can significantly lower quality and yield.	Recommend taking a close look at various herbicide options, but don't completely eliminate weed management strategies. Evaluate specific weeds to be managed.
Reduced insect sprays	Insects can cause significant losses, lowering yields and quality, sometimes for many cuts.	Do not forego insect management, but apply careful IPM principles considering economic thresholds. Strategies such as early cutting may help.
Reduced Irrigation Water	Can significantly lower yields.	Water has such a large and direct effect on yield that full irrigations are generally recommended. However, closely follow ET to make sure you're not overwatering. If irrigations are to be cut back, irrigate fully for parts of the season to maximize yields for the early cutting periods, and forgo later cuttings to control watering and harvesting costs. We generally do not recommend watering after last cutting.
Modifying harvest schedules to favor higher quality	Could lower yields and threaten stand longevity with too-early harvests.	Changing your harvest schedule to favor high quality when the market rewards quality makes sense. However, a mix between short- and long-harvest schedules may assure that high yields are still maintained.
Eliminate or reduce fertilizers	Can produce significantly lower yields on some soils	Completely eliminating fertilizers doesn't make sense, but could be done short-term if soil levels are high enough. Use soil and tissue test and definitely apply P and other nutrients when a response is expected. Increase attention to sampling and analysis