ALFALFA STRATEGIES DURING DROUGHT

Field Day Handout, Davis, CA, 12 May, 2015

Dan Putnam, Alfalfa and Forage Specialist, UC Davis
Steve Orloff, Farm Advisor, UC Cooperative Extension, Yreka

Conventional wisdom would suggest that alfalfa would be one of the worst crops to have in a drought year. However, this is not the case. Alfalfa has several unique and positive values when it comes to water, especially during drought periods.

Up until about 2 years ago, alfalfa was the single largest crop user of agricultural water in the state. Currently, with between 850 and 900,000 acres of alfalfa, it is likely now the second highest compared with almond, which has increased in acreage in recent years.

First a clarification—alfalfa's water impact is not because it somehow consumes more water than any other crop. At full canopy, alfalfa's water use is not much different than any other crop (think spinach, lettuce, wheat, almonds or corn). The Evapotranspiration (ET) requirement of these crops at full canopy per unit time is remarkably similar (see FAO tabulated values for the water requirements of crops). It is the high acreage and season-long growth patterns (from February through October) which make alfalfa's water use profile higher than many other crops.

UTILIZING BIOLOGICAL FEATURES OF ALFALFA IN A DROUGHT

Alfalfa has a range of biological characteristics that make it very useful when a farm or an irrigated region is faced with drought conditions and resulting water limitations. What are these characteristics and why are they useful?

Deep-Rootedness—alfalfa roots are normally 3-5 feet, and can extend to 8-15 feet into the soils. Therefore this crop can utilize deep moisture when surface waters become scarce.

Perenniality—The fact that the crop grows for 4-8 years, grows immediately with warm conditions in the spring is a major advantage of alfalfa—it can utilize residual winter rainfall before irrigation is necessary– supported only by rain and residual moisture.

High Yields—Alfalfa is a very high yielding crop plant, and can grow 365 days a year in warm regions. The tons produced per unit water are thus very high—more crop per drop.

High Water Use Efficiency—Because the entire above-ground plant is harvested, the economic yield/unit water is high, unlike grain or fruiting plants, where only a portion of the plant is used.

Salt Tolerance/Ability to utilize degraded water—Alfalfa has a high degree of salt tolerance, thereby can use degraded recycled water (municipal wastes, manure water) instead of fresh.

Ability to Survive a Drought—Although yields are highest with full irrigation, alfalfa can survive periodic droughts. This is due both to deep roots as well as ability to go 'summer dormant' under dry conditions.

Contribution to Wildlife Habitat—The water used in alfalfa contributes significantly to habitat – about 28% of the wild species in CA use alfalfa for either cover, feeding, or nesting – a lot of

this habitat is due to surface water irrigation. This is important when balancing ag. with environmental uses of water.

Ability to Deficit irrigate: Obtain Partial yields—Typically 50-60% of full yields are obtained by mid to late June (Figures 1, 2). If only partial water is available, irrigation water can be applied early (supplemented by winter rains and residual moisture), and the crop dried down during late summer periods. This is particularly important, since water is scarcer in late summer vs. early, and that water may be used for other crops or uses, or economically transferred to cities. Additionally, Water Use Efficiencies are greatest early in the year, and yield and quality tend to be higher early vs. late (Figure 3).

FLEXIBILTY IS THE KEY VALUE OF ALFALFA DURING DROUGHT

It is this combination of deep roots, ability to utilize rainfall early in the year, high water use efficiency, ability to survive droughts, salinity tolerance, and ability to give partial yields with half or less of the irrigation water that makes alfalfa particularly valuable in a drought. UC work done over the past 20 years has confirmed the ability for growers to stop alfalfa irrigations in mid-summer, allow the crop to dry down, and re-water successfully later when irrigation water becomes available. One cannot do this with many other crop species. This flexibility is an important role of alfalfa in cropping systems during water-short periods.

WHAT ARE THE STRAGEGIES FOR A LOW-WATER YEAR?

There are three basic strategies to cope with a reduced water year:

Option 1 – Triage - Reduce irrigated acreage of alfalfa (cease irrigating some fields while fully irrigating others). This strategy makes sense especially if some fields are older, less productive, or near the end of their stand life anyway.

Option 2 – Starvation Diet - Deficit-irrigate the entire acreage continuously during the crop season (less water per irrigation or fewer irrigations) so that less than full potential ET is applied. Unfortunately, yields can be dramatically reduced with this concept. In addition, there are increased costs per ton associated with having to apply herbicides or insecticides and harvest costs to the entire acreage.

Option 3. "Cold Turkey" Summer Cut-offs- Fully irrigate all fields for the early cuttings and then cease irrigation part way through the season when alfalfa ET demands are high. A very high percentage of yield is obtained by mid-June or July in most California locations (Figure 1,2)

USE BOTH 'TRIAGE' AND 'COLD TURKEY' FOR LOW-WATER YEARS

We recommend a combination of Option 1 (triage) and Option 3 (summer cutoffs) to deal with droughts.

Triage. When faced with low water years, the older, least productive fields must go, especially if water can be moved to more profitable crops or economically transferred for other uses.

Recommendations: When the stem count for a field, averaged over about 6-10 observations, are less than about 35 per ft^2, it's time to consider rotation to another crop anyway. This is

equivalent to about <4-5 plants per ft^2 plants/ft2. Weed intrusion and health of the plants should also be considered.

'Summer Dry Down – Cold Turkey Cessation of Irrigation. In most cases, we believe that provided there is sufficient water available early to mid-season, the third option may be the most economical choice for productive fields. Growers should assure that fields have a full profile of water at the beginning of the season, calculate the water available, and water fully to a mid-point in the season and then quit. For example, if only 2 AF of water may be available (out of a seasonal requirement of 4 AF), water until 2 AF is used, then stop.

The reasons this strategy may be best is several fold:

1) Alfalfa exhibits superior yield patterns early in the year – Figures 1-2 show the percentages of alfalfa yields realized in the early cuts of the year, depending upon location. This is also the period for highest quality.
2) Water may be more available or cheaper during early periods, and less available later.
3) 2-3 month dry-downs can save money on pest management requirements as well as harvesting costs for the latter half of the year.

*Recommendations***:** Calculate the seasonal water use and the amount of available water available to you – continue full irrigation through a mid-summer time point, and then cease irrigations. Monitor stands in late-summer and fall for survival.

Some alfalfa growth continues even after irrigation water is withdrawn utilizing stored soil moisture. Because yields are typically higher in spring and the ET rate is less than the summer, the water use efficiency (yield per unit of water) of the applied water is greater in spring than in mid-summer or fall (Figure 3). For this reason, if water supplies are low and the grower is forced to deficit irrigate, returns should be higher when the crop is fully irrigated in the spring than when the water is applied later in the year. In addition, alfalfa forage quality is higher in spring than summer and therefore demands a higher price.

This does not mean that there won't be a yield penalty from late-season water cutoffs – there will be. However, the extent of the seasonal reduction will depend upon a range of factors – particularly the ability of the soil to store moisture.

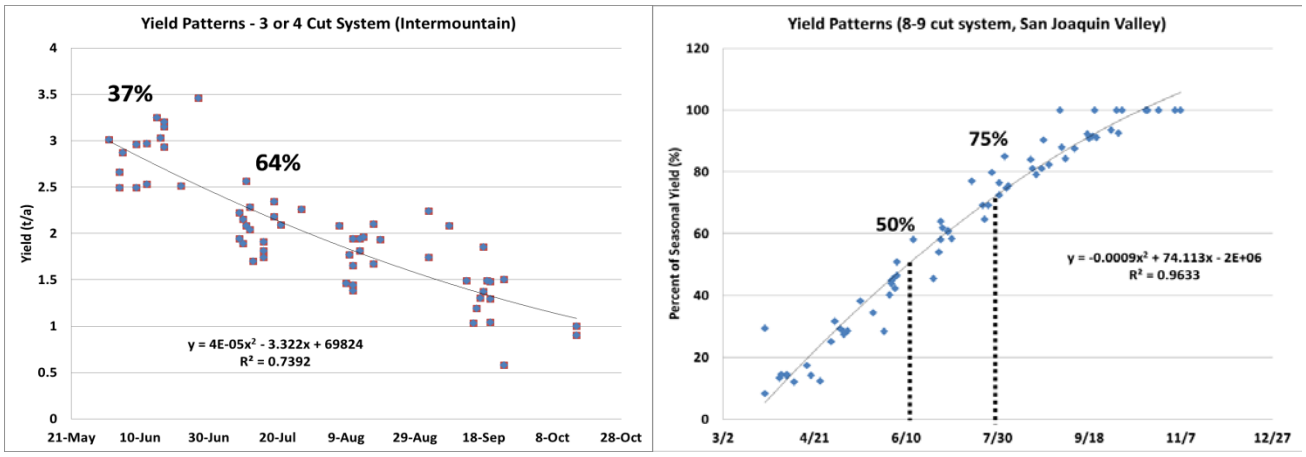

Figure 1. Yield patterns from University of California Alfalfa Variety Trials in a 4 cut system (Intermountain), and a 8-9 cut system (Fresno County). Typically, 50-60% of full yields can be obtained by mid June, making partial-season production feasible if water supplies are short.

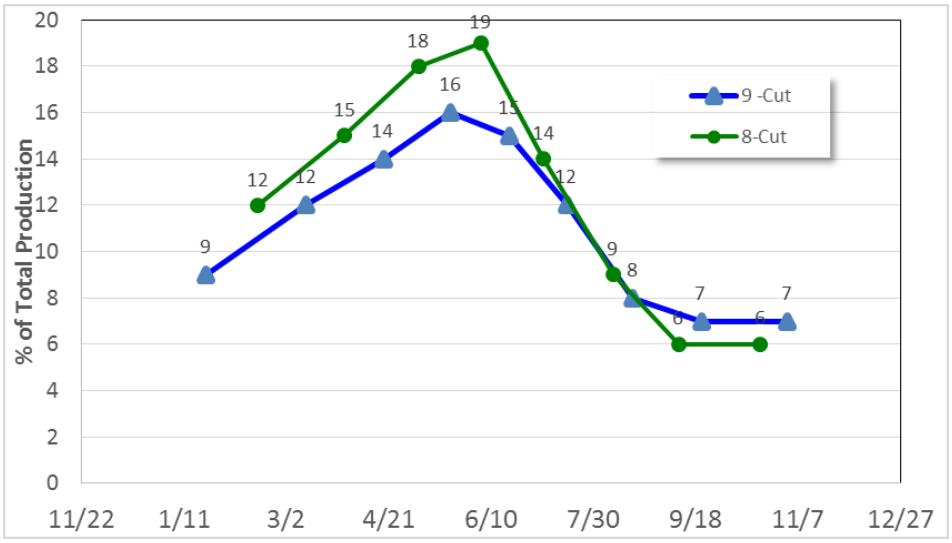

Figure 2. Percent of total seasonal production that occurs at the UC Desert Research and Extension Center in Imperial County for 8 and 9 cutting schedules.

Sacramento Valley Studies. Yield reduction with a July irrigation cutoff in the Sacramento Valley studies ranged from 0.5 to 2.7 tons per acre, again depending mostly on soil type and soil moisture status (Figure 4). The seasonal yield reduction wasn't much less when the field was re-watered again in the fall. The amount of yield saved with a fall irrigation compared with the July cutoff and no subsequent irrigation that season was less than half a ton in most cases. Therefore a single fall irrigation after a summer drought is generally not recommended in this area.

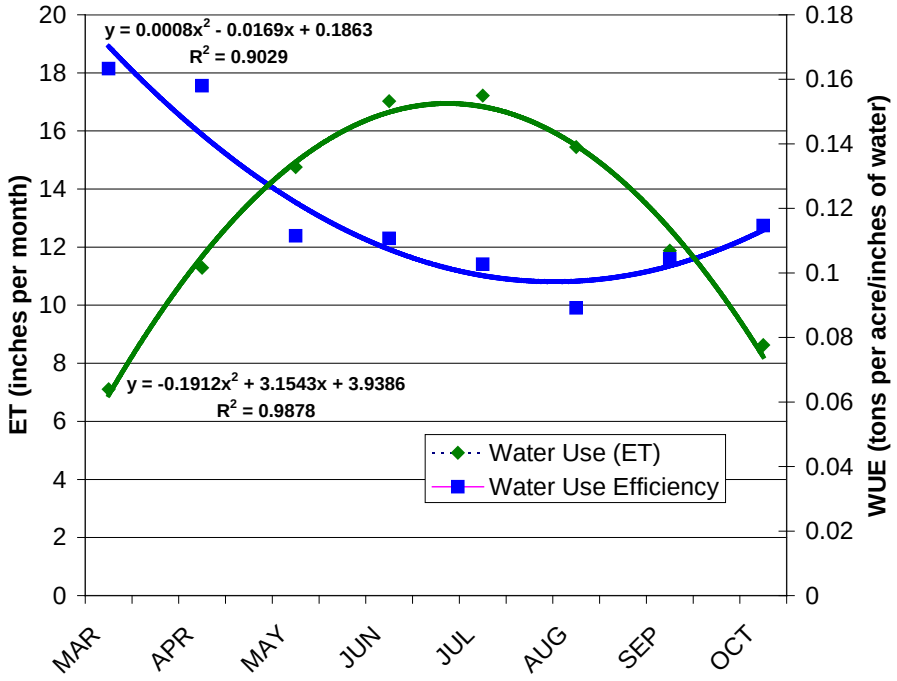

Figure 3. Seasonal water use (ET in inches per day) and water use efficiency (tons per acre inch of water) for alfalfa in the Sacramento Valley.

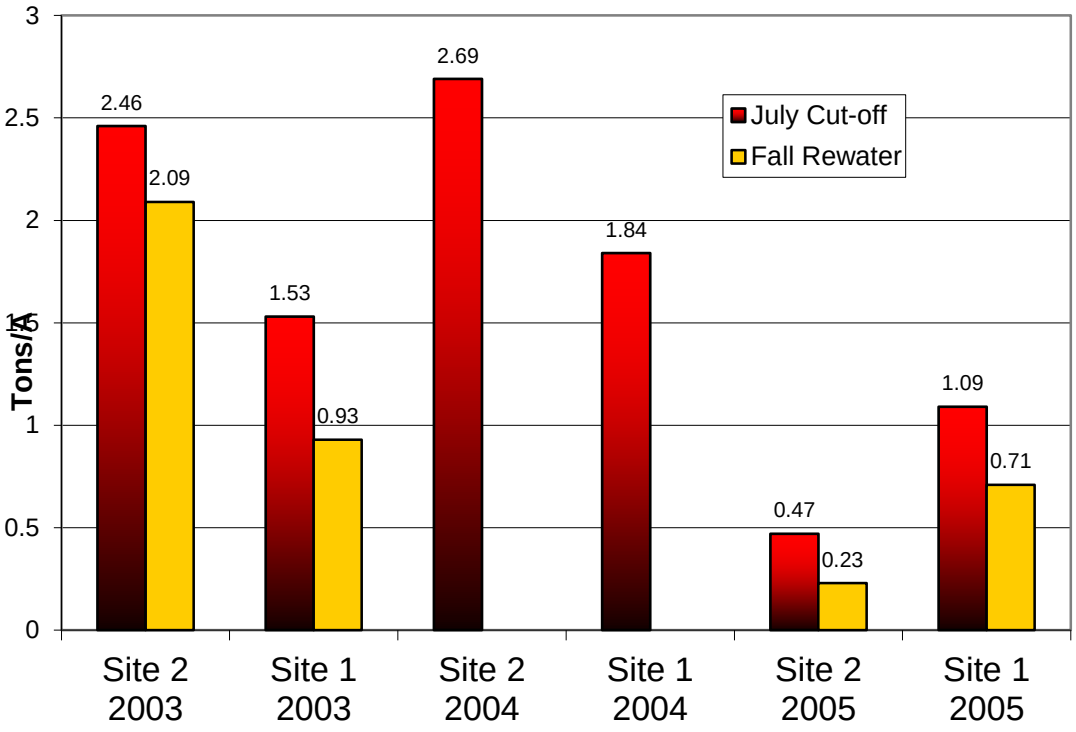

Figure 5. The reduction in alfalfa yield from a July irrigation cutoff or a July cutoff with fall irrigation compared with full-season irrigation in the Sacramento Valley.