Sacramento Valley Field Crops Newsletter

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University of California
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In This Issue

Submitted by:

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Sutter-Yuba and Colusa Counties

Nitrogen Management Seminar

Although most of this year's wheat has likely been planted, the cost of fertilizer and an unpredictable rainy season mean it's never a bad time to learn more about how to improve nitrogen management in small grains.

Join us for a nitrogen management seminar being offered in the Sacramento Valley on February 23rd in Yuba City. The seminar will cover a range of topics related to the use of the Nitrogen Fertilizer Management Tool for California Wheat.

Over the years UC Agronomy Advisors and Specialists have had considerable success using the Webtool and working with growers to optimize nitrogen fertilizer inputs in small grains. The tool and some of the methods behind it have been able to improve grower margins by reducing inputs costs or recommending appropriate amounts of in-season fertilizer to ensure yield potential.

CCAs and other crop consultants will benefit from an improved understanding of nitrogen management in small grains that can be used to better advise their clientele. Growers will benefit from a better understanding of in-season crop needs and what types of information can be gathered to inform their crop fertility decisions. Details below. Please contact Sarah Light selight@ucanr.edu for questions.

Thursday, February 23, 2023
142 Garden Hwy, Yuba City, CA 95991
9:00 a.m. - 11:00 a.m.

2023 California Plant and Soil Conference

The Plant and Soil Conference is back in person for 2023! This event showcasing relevant, applied research from California is back in person February 7th and 8th in Fresno.

The agenda is finalized and registration is open: https://calasa.ucdavis.edu/
This event is coordinated by the California Chapter of the American Society of Agronomy. Please contact Sarah Light selight@ucanr.edu for questions.

American Society of Agronomy
California Chapter

Project Update: The Effect of Almond Shell Mulch on Productivity of Established Alfalfa Fields.

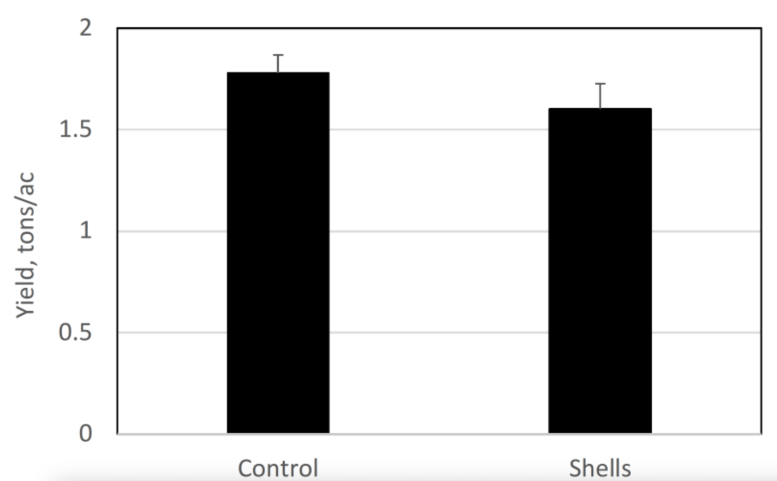
Sarah E. Light, Agronomy Advisor, University of California Cooperative Extension
Rachael F. Long, Farm Advisor for Field Crops and Pest Management, UCCE
Clair Akin, Cover Crop Selection Tool Coordinator, University of California Cooperative Extension

Recent regulations, incentive funding, and the state's goal of reducing organic matter into the waste stream has led to increased organic matter application to California Farmland. With increasing limitations on burning orchard byproducts, some alfalfa growers have applied almond shell mulch to their fields. The application of almond shells to alfalfa is best suited for older, established stands and/or for Roundup Ready alfalfa. This is because almond shell application will interfere with pre-emergence herbicide applications. Almond shells are high in carbon and low in nitrogen (N). Concerns about N immobilization in the soil surface are reduced due to N fixation by alfalfa and the deep rooting structure. There is a need to understand how almond shell application impacts alfalfa stand productivity including yield and weed pressure. This is a summary of information collected mid-project by UCCE Farm Advisors Sarah Light and Rachael Long.

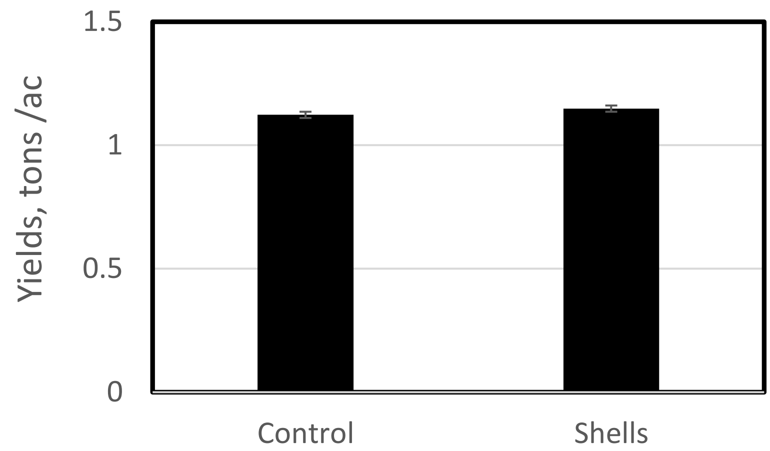
Almond shells after application.

Almond Shells were applied in the Fall of 2021 to a three-year-old alfalfa stand at a rate of four to eight tons per acre with four replications. On April 8th, 2022 and October 17th, 2022, plots were hand harvested prior to grower harvest. Two square meters were sampled from each plot in three locations per plot. Percent cover of weeds, alfalfa and bare soil were also collected on all harvest dates. Following first cutting, on April 30th, 2022, stand counts were collected to evaluate the potential impact of almond shell application on future stand performance. By spring 2022, almond shells were no longer visible.

Data collected to date indicates that there was no difference in yield between plots that had almond shells and those that did not. Yield differences were not measured between treatments at either harvest date. Almond shell application to established stands does not appear to increase or reduce yields of established alfalfa stands.

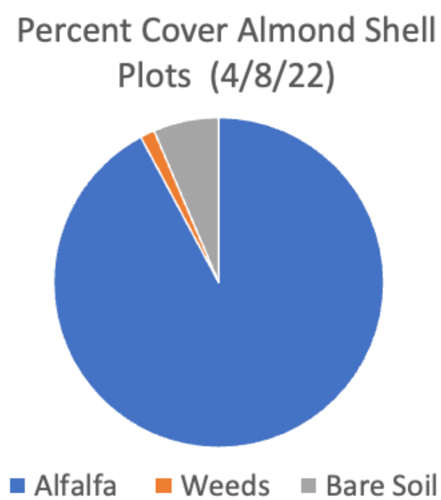


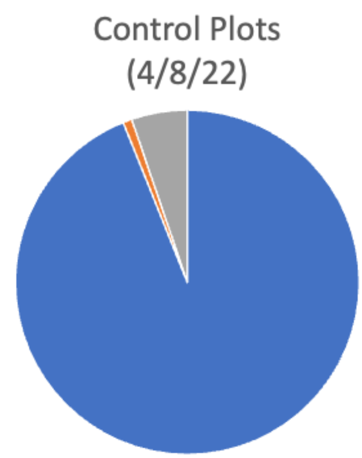
Yield Data from April 8th, 2022.

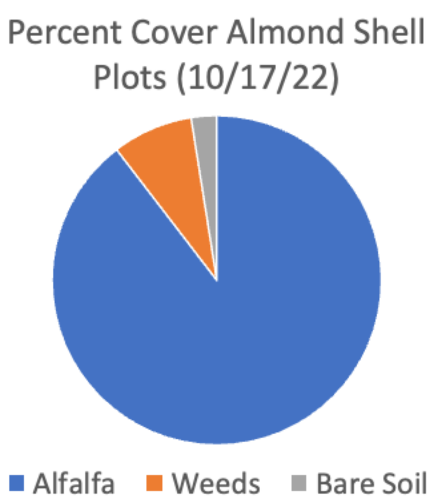


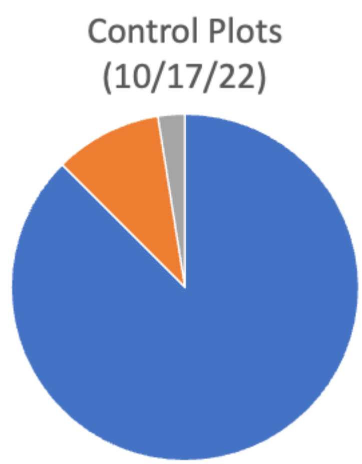
Yield Data 10/17/22.

Almond shell application did not affect the percent alfalfa, weeds or bare soil between treated and untreated plots either in the spring at first cutting or the following fall, a year after almond shell application. In the first year of the project, the application of almond shells did not affect the percent of alfalfa, weeds, or bare soil.

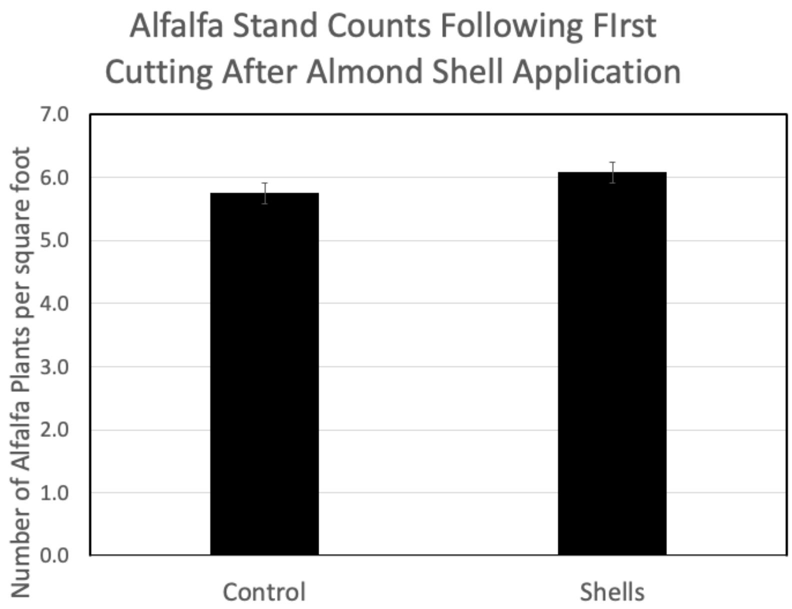








Alfalfa stands were consistent between treatments and not affected by almond shell applications. This data indicates that there isn't a negative impact to applying almond shells alfalfa fields.



Almond shell mulch application to established alfalfa fields does not appear to negatively affect alfalfa stand productivity in the first year after application. Alfalfa fields may provide an opportunity for diverting almond shells from nearby orchards, improving organic matter recycling in the region. This project will be continued for a second year. To try to measure differences between treatments, almond shells were applied on 11/19/22 at an increased rate of 12.5 tons/A to the same areas that had previously had almond shells applied. Yield measurements, percent cover measurements, and stand productivity measurements will be continued for the next year. In addition, the effect of almond shell application on soil nutrients and soil health will be quantified. Soil moisture measurements will also be collected.

Thank you to the California Alfalfa and Forage Research Foundation for funding this project, and to our farmer collaborator without whom this work would not be possible. Please contact Sarah Light, selight@ucanr.edu, or Rachael Long, rflong@ucanr.edu,for more information.

California Small Grain Variety Performance under Conditions of Drought and Nitrogen Stress

Mark Lundy, UC Cooperative Extension Specialist, Grain Cropping Systems

UC Cooperative Extension conducts annual small grain variety trials in production environments that span the state of California. From these experiments we measure and report a wide range of agronomic traits on an annual basis, including grain yield, grain quality, stress stability, disease reactions and other agronomic characteristics.

Drought and N stress are frequent, yet unpredictable, features of small grain production in California. Because of this, variety performance assessments that directly incorporate these effects serve as a useful predictor of performance across a broad range of production environments. As a result, at a subset of trial locations, we replicate our common wheat and triticale trials with contrasting nitrogen and water management to create the following management conditions:

1) *Conventional management:* Water and nitrogen fertility delivered to optimize productivity.
2) *Low nitrogen management:* No nitrogen fertilizer provided, with the objective of restricting nitrogen availability to limit crop growth. Water is not limiting.
3) *Low water management:* Irrigation is restricted such that water will limit crop growth during grain filling, creating terminal drought conditions. Nitrogen fertility is managed to avoid nitrogen deficiency.

These side-by-side trials help to differentiate the effects of nitrogen and water limitation on the performance of common wheat and triticale in California. From these data, we can identify varieties that perform well in conditions of abundance as well as under drought and nitrogen stress. Stress stability is measured as the relative performance of an individual variety in the unstressed conditions plus or minus its relative performance in the stressed conditions at the same location.

We summarize this performance across multiple years of trials to produce stress stability scores for each variety. These scores indicate the grain yield, protein yield and protein stability of individual varieties across conditions of terminal drought and N stress. Figure 1 summarizes these results for trials conducted between 2019 and 2021. The darker blue indicates higher stress stability and the darker red indicates low stress stability.

Notable trends in these data include the fact that triticale yields are more stable under conditions of N stress than common wheat, but results are more mixed for comparative yield stability under terminal drought conditions. In addition, varieties with higher yield stability tend to have lower protein stability, and vice versa. Also, variety performance under conditions of drought stress and N stress is not always consistent.

Because water is generally more limiting to crop growth than N (and can co-limit N), drought stress tends to reduce yields more so than N stress. As such, stress stability under drought conditions in our trials tends to be a good predictor of variety performance in rainfed or partially-irrigated environments across California. Meanwhile, N tends to limit crop growth when water is not limiting and this most frequently occurs in high yielding, fully-irrigated environments. Therefore, N stress stability in our trials tends to be a good predictor of variety performance in higher-yielding, irrigated environments across California.

Of note is that the stress stability information highlighted in this article supplements our general variety performance summaries, which are produced across a broader range of production environments and offer additional information and context for variety performance. When deciding about what variety to plant, stress stability should be considered in tandem with the broader set of statewide variety performance data, especially if terminal drought and/or N limitations are occasional features of the cropping system in question. The full suite of small grain variety selection information can be found on the UC Small Grains Research Information Center website under the Variety Selection section (https://smallgrains.ucanr.edu/Variety_Selection/). More information about the stress stability trials highlighted in this article is available as a link on the Variety Selection page and also available here: http://smallgrains.ucanr.edu/Stress_Stability/.

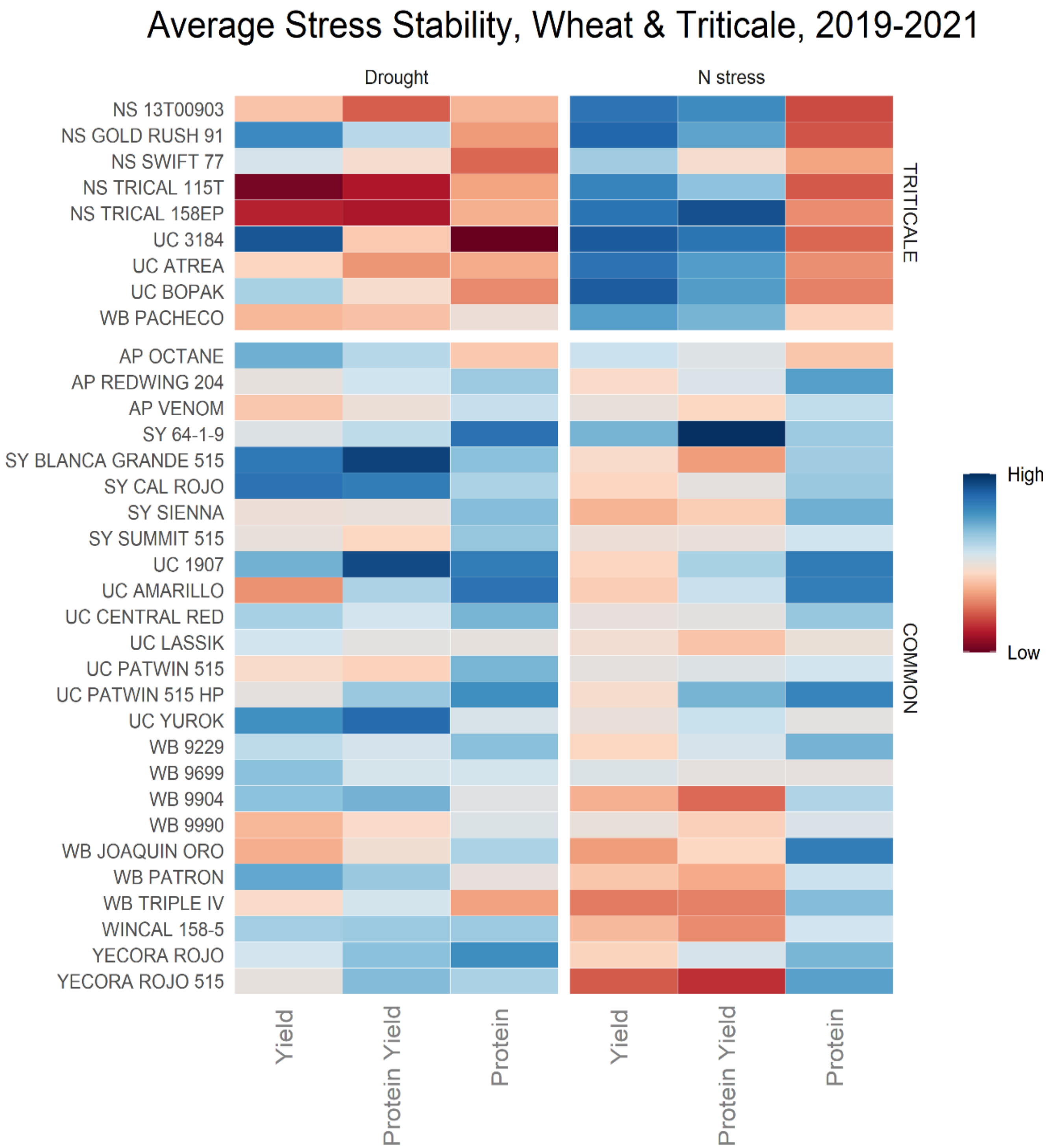


Figure 1. Heat map indicating average stress stability for yield, protein yield and grain protein of common wheat and triticale genotypes tested between 2019 and 2021 in paired trials containing normal management conditions and managed N and terminal drought stress gradients.

Development of New Alfalfa Products in Combination with Almond Hulls for Emerging Domestic and International Markets

Katherine Swanson, Maia Zack, Ed DePeters, and Daniel Putnam
Department of Plant Science and Department of Animal Science, UC Davis

There are over two million tons of almond hulls produced each year as a by-product from 1.2 million acres of almonds currently being grown in California (Almond Almanac, 2020). Alfalfa acreage has decreased in recent years, but alfalfa still remains an important commodity in California and was produced on over 580,000 in 2021. Almond hulls (the soft by-product of harvesting the almond nuts) serve as an excellent high-energy and fiber rich by-product feed, but lack sufficient protein and effective fiber for optimum rumen function in ruminants such as cattle (DePeters et al., 2020). Alfalfa has many of the characteristics required by ruminants and is a highly valued diet ingredient of lactating dairy cows, particularly for its digestible energy, effective fiber, and digestible protein. In this study, we sought to determine if different combinations of alfalfa and almond hulls could utilize the nutritional benefits of each product to develop new feed products to be utilized both domestically and internationally.

In the fall of 2020 alfalfa of four qualities (high, medium, low/medium, and low quality) were obtained alongside almond hulls of common quality. We created 17 different samples to use for analysis by combining almond hulls with each of the four qualities of alfalfa, resulting in mixes that were 0, 25, 50, or 75% almond hulls by weight. There was also one sample of 100% almond hulls.

<u>Lab Incubation:</u> In the lab, each of the 17 samples was incubated in large glass syringes with rumen fluid collected from the rumen compartment of the stomachs of cows. These incubations allowed us to measure gas produced during the fermentation (digestion) of each of the different feed samples. Total amounts of gas production at 24 hours were used to estimate the metabolizable energy from each sample. In addition, the digestibility of each sample was measured by incubating each sample in jars containing rumen fluid for 24, 30, or 48 hours. Each jar was removed from the incubator at a different time point, allowing us to measure how much of each feed sample disappeared (was digested) at each timepoint.

This study found that the Low/Medium quality alfalfa mixed with 25 or 75% almond hulls had improved dry matter and fiber digestibility compared with the pure Low/Medium alfalfa alone. In addition, the Low/Medium alfalfa with 50 or 75% almond hulls had calculated metabolizable energy values that were comparable to that of the pure High quality alfalfa. In other words, it appears that almond hulls may provide an opportunity to improve the nutritional value of lower quality alfalfa. Lower quality alfalfa is not typically fed to high producing dairy cows, but the addition of almond hulls could make it a more viable feed option for dairy cattle and improve its marketability.

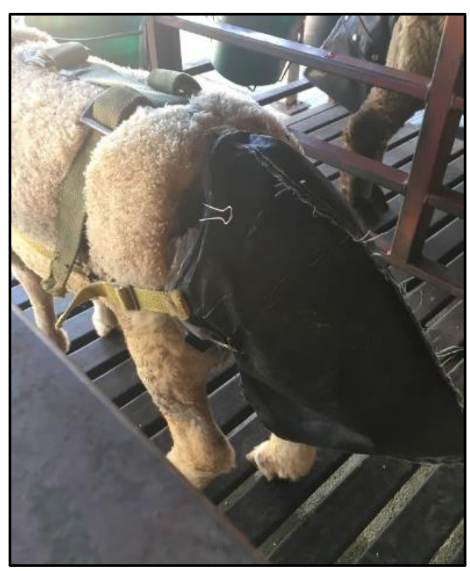


Figure 1. Sheep wearing fecal collection harness

<u>Sheep Study:</u> We selected the four treatments that performed best in the laboratory study for our sheep digestibility study. These diets consisted of cubed pure Low/Medium quality alfalfa hay, along with cubed mixes of Low/Medium alfalfa and 10, 20, or 40% almond hulls. Eight sheep were fed each of the four unique diets. The study design was a replicated 4x4 Latin square experimental design. In a Latin square design, every animal will switch diets at the end of each 14-day time period so that by the end of the 56-day study, every animal will have consumed each diet. During the last 7 days of each time period, the sheep were fitted with a fecal-collection harness to allow for total collection of feces. The amount of feed consumed and the amount of

feces produced was measured for each sheep-diet combination. Feed and feces were analyzed for chemical composition. With this information we were able to determine the overall digestibility as well as the digestibility of protein and fiber of each of the 4 cubed diets.

The alfalfa cubed with 10% almond hulls had the highest overall dry matter digestibility as well as the highest crude protein digestibility (Table 1). As the percentage of almond hulls increased, protein digestibility decreased. Fiber digestibility also decreased as the amount of almond hulls in the cubes increased to 20 and 40%, suggesting that the fiber in almond hulls is not very digestible. The cubes with 10% almond hulls did not have a significant drop in fiber digestibility though.

Table 1. Sheep digestibility of dry matter (DM), organic matter (OM), crude protein (CP), and acid detergent fiber and neutral detergent fiber on an organic matter basis (ADFom and NDFom respectively) for low/medium quality alfalfa cubed with 0, 10, 20, or 40% AH (almond hulls).

	0% AH	10% AH	20% AH	40% AH	SE
% Digestibility					
DM	59.5^{a}	62.9^{b}	61.7^{b}	61.3^{b}	0.65
OM	60.9^{a}	64.1^{b}	62.3^{a}	61.5^{a}	0.66
CP	70.8^{a}	72.1^{a}	67.6^{b}	55.6^{c}	0.83
ADFom	45.8^{a}	43.0^{a}	39.1^{b}	34.8^{c}	1.13
NDFom	44.7^{a}	42.8^{a}	38.9^{b}	36.6^{b}	1.38

[a-c] Different lettered superscripts denote significant differences in averages ($p<0.05$) for each nutritional component.

Preliminary Conclusions and Future Work: Overall, this research suggests that there are potential benefits for digestibility in both laboratory and animal models when low amounts (e.g.10%) of almond hulls are mixed with lower quality alfalfa. However, there is no benefit to mixing almond hulls with higher quality alfalfa hay. Cubing low amounts of almond hulls may add value to lower quality alfalfa hay as it can increase the overall dry matter and crude protein digestibility with only slight decreases in fiber digestibility. From a practical perspective, this could increase the potential marketability for lower quality alfalfa while the cubing process would make them easier to ship both domestically and internationally. We recently conducted a study with dairy cattle where we fed different diets containing cubes with various amounts of almond hulls and medium quality alfalfa hay, but are still in the process of analyzing those results.

This work was funded by the National Alfalfa and Forage Alliance Checkoff Program. Alfalfa samples were donated by the California Alfalfa and Forage Association and almond hull samples were donated by the Almond Board of California.

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