

# Comparison of Productivity and Efficiency of Grass-Only and Grass-Legume Beef Stocker Grazing Systems

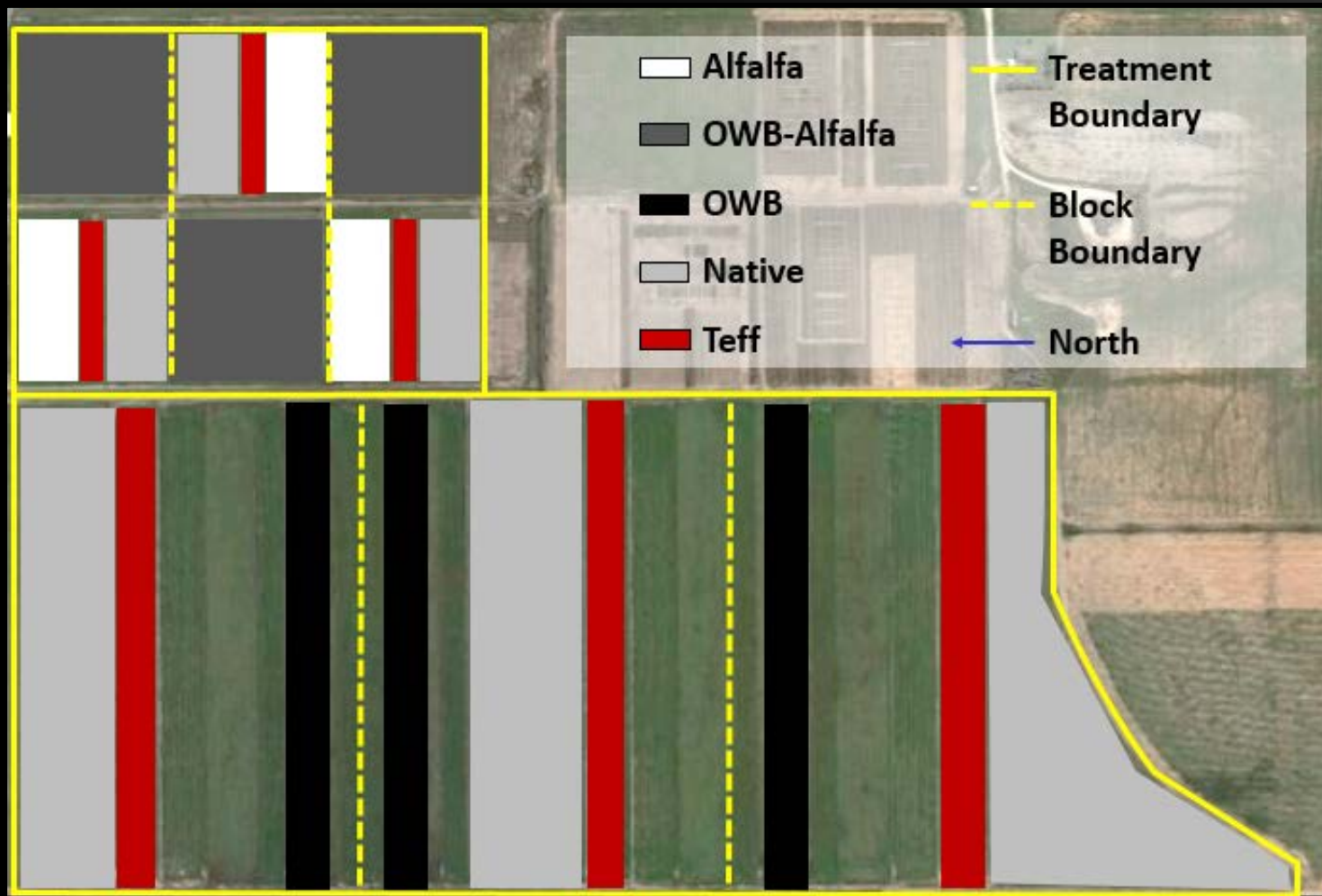
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## Introduction

- The imminent depletion of the Ogallala Aquifer demands shifts to dryland or limited-irrigation alternatives to prevent dramatic losses of income as water levels are insufficient for irrigated row-crops in the Southern High Plains (SHP).
- Previous research demonstrated the success of perennial grasses in the SHP (Allen et al. 2012). Legumes such as alfalfa can improve farm systems by:
  - Reducing or eliminating nitrogen fertilizer requirements
  - Improving stocker gains
- Objective:** compare productivity and efficiency of a grass-legume (GL) pasture system employing novel forages and grazing techniques to a grass-only (GO) pasture system.

## Materials and Methods

- Two grazing treatments (three replicates) with fixed stocking rates (avg. initial weight: 509 ± 47 lbs/hd; GO: 0.58 hd/ac; GL: 0.77 hd/ac; Fig. 1).
- Forages: WW-B.Dahl old world bluestem (OWB); Natives: buffalograss, blue grama, and sideoats grama; Teff; Legumes: alfalfa and yellow sweetclover
- Blocks of stockers were rotated among pastures within treatment replicate based on forage availability.
- Stockers in GL treatment were allowed limited access to alfalfa protein bank (4 h, 3 times/wk in YR 1; 48-72 h, 1 time/wk in YR 2).
- Six, 1-m<sup>2</sup> samples collected for all pre- and post-grazing events.
- Soil volumetric water content (VWC) monitored weekly with Dynamax PR2 Profile Probe System (Dynamax Inc., Houston, TX; Fig. 2). 60 total soil access tubes on site.
- Water use efficiency (WUE) = total liveweight gain/total water delivery; units: lbs LWG/acre-in water.



**Figure 1.** Overview of experimental area: solid lines outline treatments, dashed lines define blocks, opaque color blocks indicate forage present in each pasture.



**Figure 2.** Capacitance probe (a) is inserted into access tube (b) for rapid VWC reading. PVC covers provide protection (c).

## Results

### Better resource management extended grazing season:

In 2014 the grazing season was restricted to 86 total days, whereas the stockers were on pasture for 115 days in 2015 (Fig. 3).

### Rainfall and Irrigation:

Above normal rainfall was recorded in both years during the grazing season (2014: 15.9", 2015: 26.6") but only fulfilled 32% and 54% of the evaporative demand, respectively. Supplemental irrigation was applied through an underground dripline system (Table 1).

### Monitoring water use:

Changes in VWC of each forage in the GO and GL treatment are given in Fig. 4 a and b, respectively. Data were used to make irrigation decisions. For instance, alfalfa was irrigated near weeks 37 and 42 to reverse rapid drops in soil water content.

### Including legumes increased CP availability:

Perennial and annual grasses failed to meet stocker CP requirements (Fig. 5). Although quality decreased throughout the season, alfalfa grazed as a protein bank could sufficiently meet the protein demands of growing stockers.

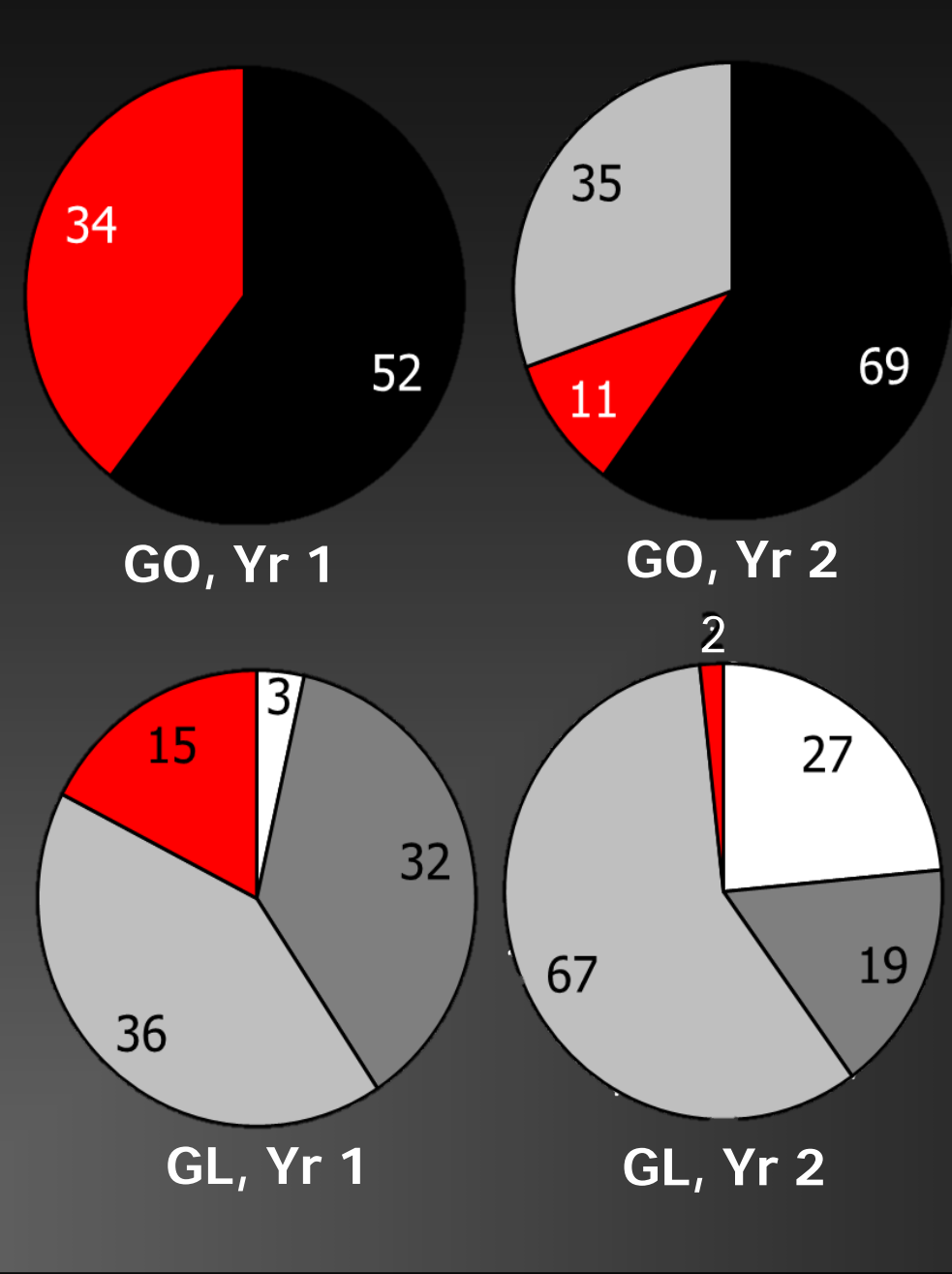
### Legumes improved overall system performance:

In YR 1, the inclusion of legumes increased average total stocker gain/ac from 253 to 327 lb/ac ( $P < 0.01$ ). Management adjustments prolonged the grazing season in YR 2, increasing total stocker LWG to 302 and 439 lb/ac for the GO and GL treatments, respectively ( $P < 0.01$ ). Although the WUE decreased in YR 2 (YR 1: 5.8 lbs LWG/acre-in water; YR 2 4.8 lbs LWG/acre-in water;  $P = 0.01$ ), inclusion of legumes increased WUE in both years (GL: 6.2 lbs LWG/acre-in water; GO: 4.5 lbs LWG/acre-in water;  $P < 0.01$ ).

## Conclusions

- Utilizing alfalfa as a protein bank can increase stocker gains/acre when grazed for one 48-72 hr period/week to maximize intake and protein bank utilization.
- Inclusion of legumes increased WUE of the GL system.
- Crude protein was limited for the GO treatment in nearly all forages across both years. The high CP content of the alfalfa protein bank was able to supplement the other lower-quality base pastures in the GL treatment.
- The Dynamax PR2 Profile Probe System is a useful tool for monitoring seasonal trends in VWC among forages in each treatment.

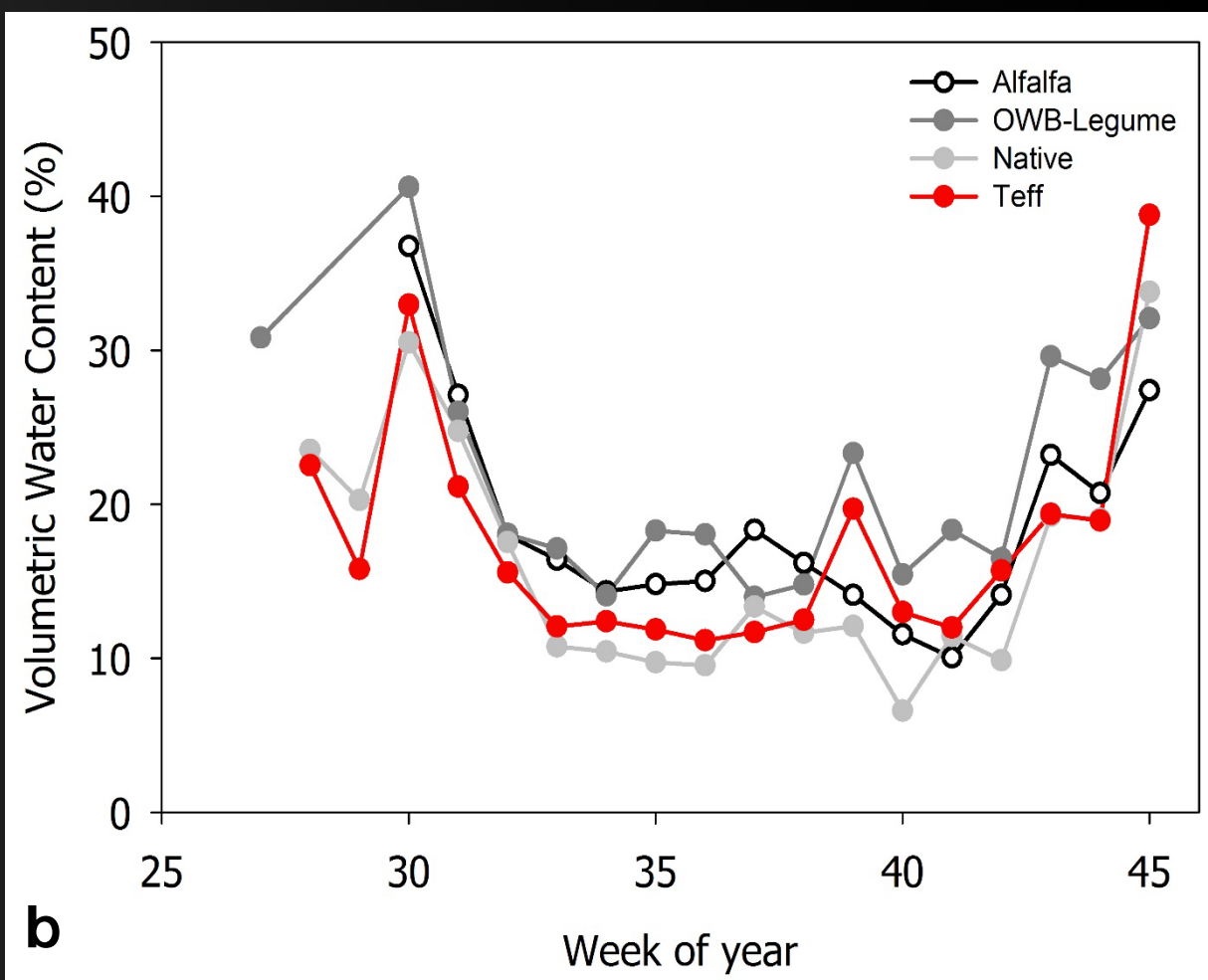
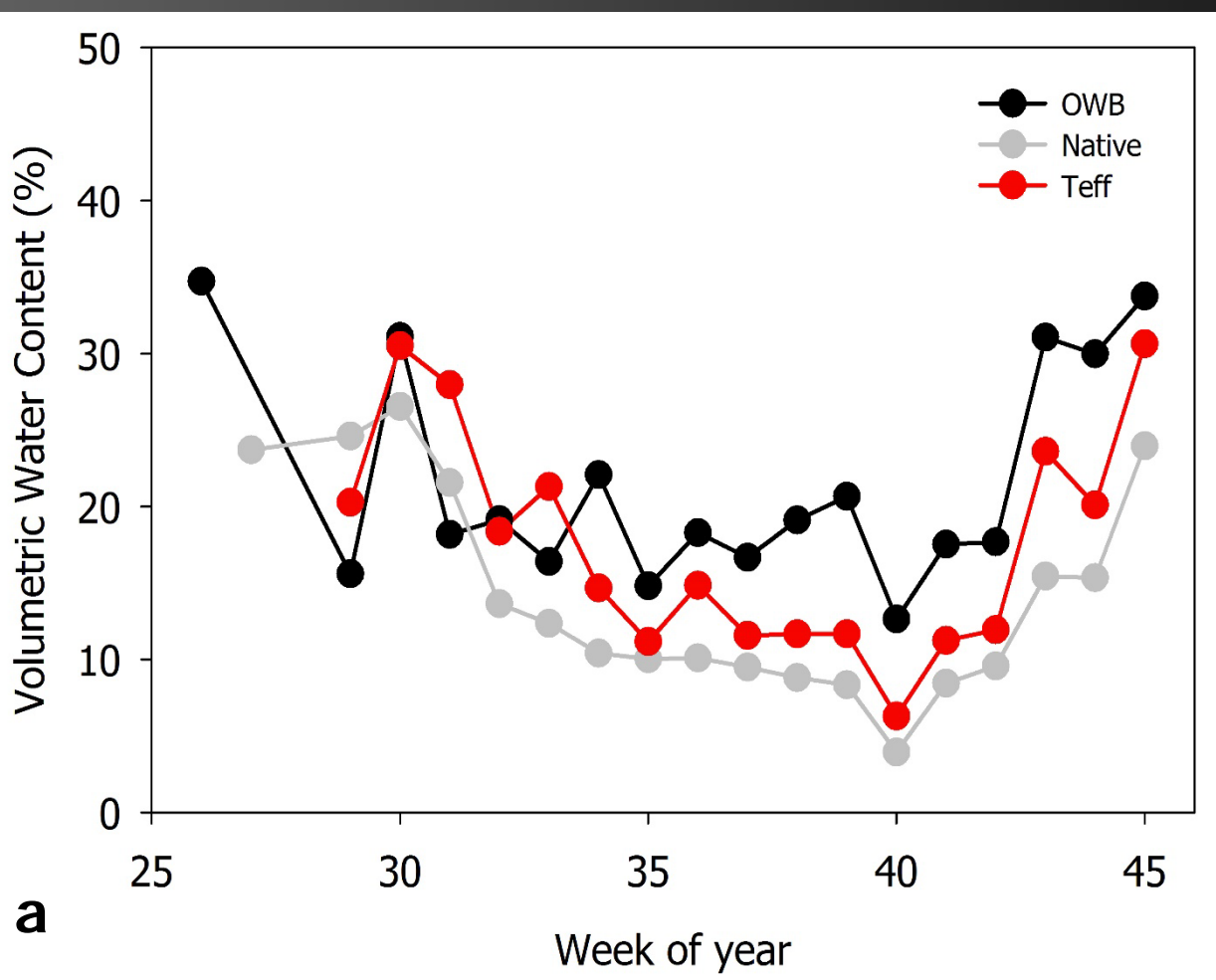
## Results



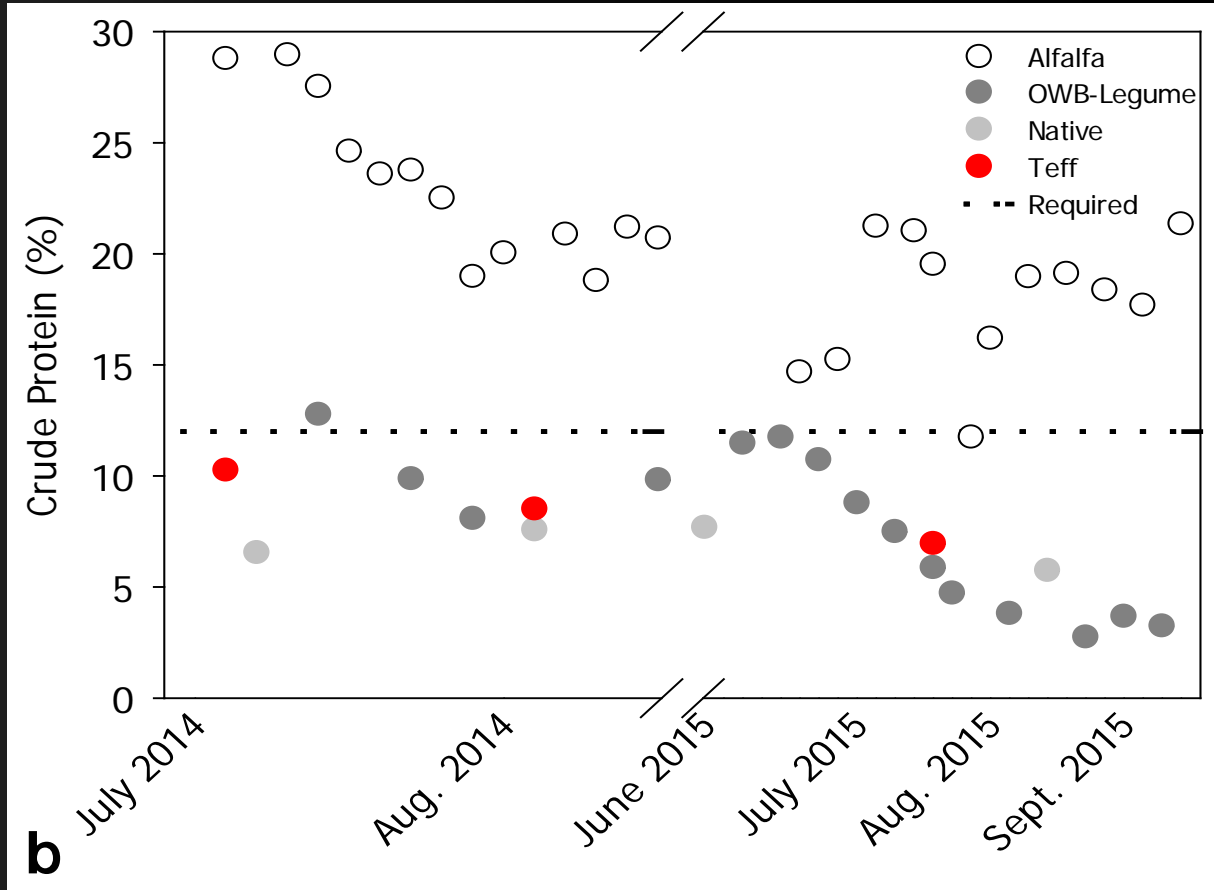
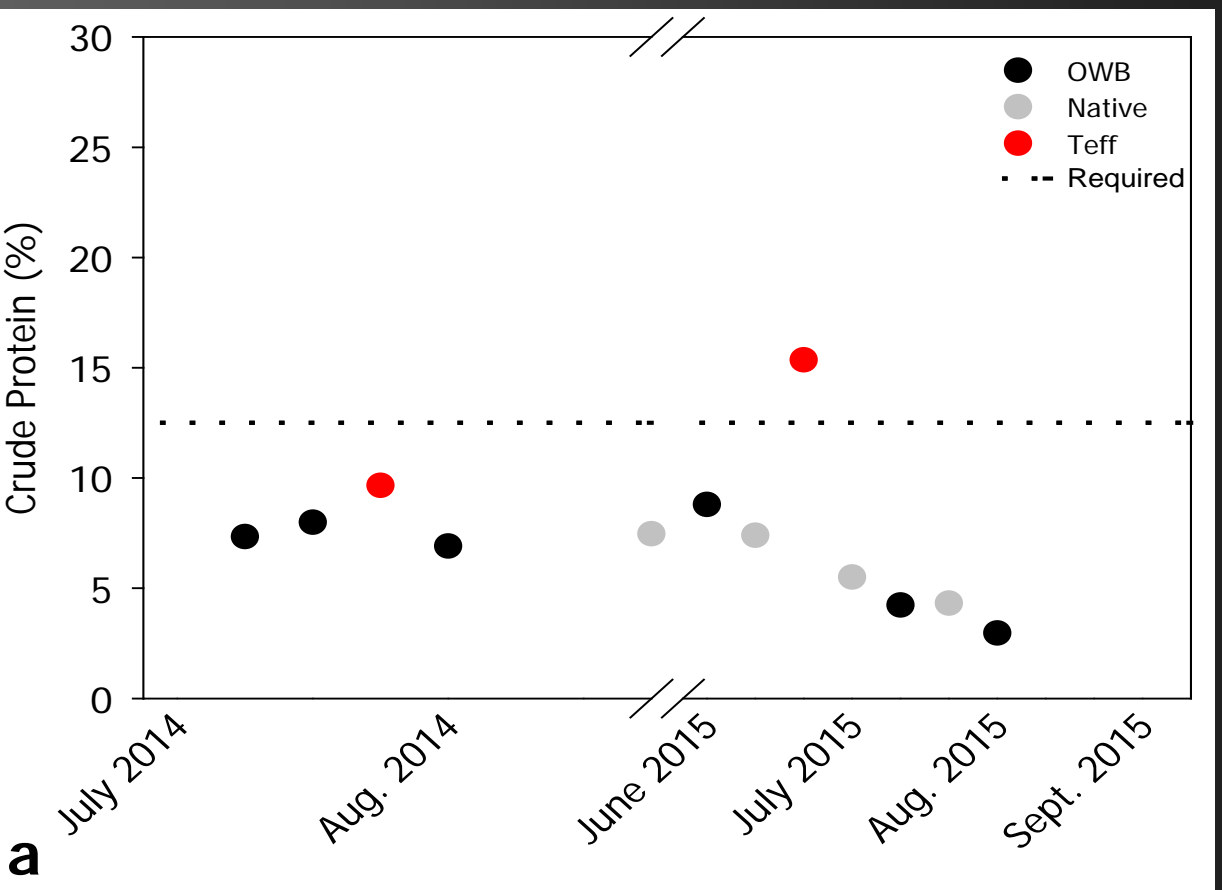
**Figure 3.** Allocation of grazing days for GO and GL treatments in each year (White = alfalfa; Lt. gray = natives; Dk. gray = OWB-legume; Black = OWB; Red = teff).

**Table 1.** Average irrigation applied each year for GO and GL systems.

System	Year 1	Year 2
---inches/system---		
GO	5.5	4.4
GL	4.6	4.3



**Figure 4.** Comparison of soil VWC at 12-inch soil depth for forages in GO (a) and GL (b) treatment in YR 2 (week 25 = June 22 2015).



**Figure 5.** Comparison of crude protein concentration among forages over time in GO (a) and GL (b) treatment (± SE bar).

## Implications and Future Work

- Integrating use of native and improved grasses with legumes in stocker production provides an option when transitioning from irrigated crops to low-water systems.
- Economic analyses will determine the net returns of the forage systems with respect to water and nitrogen use.

## Selected References

Allen, V.G., C.P. Brown, R. Kellison, P. Green, C.J. Zilverberg, P. Johnson, J. Weinheimer, T. Wheeler, E. Segarra, V. Acosta-Martinez, T.M. Zobeck, and J.C. Conkwright. 2012. *Agronomy Journal* 104:1625-1642.  
Allen, V.G., C. Batello, E.J. Berretta, J. Hodgson, M. Kothmann, X. Li, J. McIvor, J. Milne, C. Morris, A. Peeters, and M. Sanderson. 2010. *Grass and Forage Science* 66:2-28.