TECHNICAL REPORT

Strategic Grazing of Alfalfa by Sheep in California's Central Valley

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November 2010

Abstract.

Grazing alfalfa with sheep during the fall and early-winter months is a practice that removes unwanted alfalfa plant material during the dormant season and provides sheep producers high quality forage at a time of seasonal forage scarcity in California. The elimination of alfalfa stems reduces the incubation substrate for the Egyptian alfalfa weevil eggs and larvae, but the effectiveness of this practice has come into question as winter temperatures rise which may shrink the period of alfalfa dormancy and increase the period of adult weevil activity. A late-winter grazing period could provide both weed and weevil control and reduce or eliminate dormant pesticide applications, but will compromise alfalfa yield at the first harvest. This project, conducted in Yolo County California, provides preliminary evidence that alfalfa yield for the first cutting only was reduced by approximately 0.5 tons/acre, which equated to a reduction in gross returns of approximately $55/acre, using May 2010 prices. This reduction may be partially or completely offset through reductions in pesticide applications and improved soil quality. Late-winter grazing may provide a valuable pest control tool in organic alfalfa production that may result in increased forage yield and quality.

Introduction.

In areas of California the practice of grazing sheep on alfalfa field during the fall and early-winter months is used to remove weeds (Bell and Guerrero, 1997) and unwanted alfalfa plant material that will become decadent by the first spring cutting and provides habitat for the Egyptian alfalfa weevil larvae. This practice, known as "sheeping off," also provides an abundant source of high quality forage for sheep producers at a time of year when rangeland forage quantity and quality can be low. This practice may be losing its effectiveness at controlling pests due to warmer winter temperatures that decrease alfalfa dormancy and increase the duration of adult weevil activity during the winter months. Observations of alfalfa fields in Yolo County that are grazed in early winter have significant weevil larvae counts in early-Spring necessitating the need for insecticide applications.

The effectiveness of sheep grazing to control the Egyptian alfalfa weevil and possibly winter annual weeds may be improved by deferring grazing to late-winter or combinations of grazing events throughout the fall and winter months. One negative consequence to late-winter grazing is a potential decrease in alfalfa yield at the time of the first cutting, which typically commands a high price. Such losses may be offset by factors such as reduced pesticide (herbicide and insecticide) applications and alfalfa re-growth. Organic alfalfa producers may also find significant benefits to strategic sheep grazing in controlling difficult pests since their pest control tools are very limited.

In order to understand the impact of late-winter alfalfa grazing on yield, we conducted a preliminary investigation on various alfalfa fields in Yolo County that were grazed during February 2010. This technical report summarizes the results of this preliminary work and suggests practices that deserve further research. These results provide insights to the effect of late-winter alfalfa grazing and may leverage a larger project addressing yield, weevil and weed control, effects on soil and the specific timing of grazing.

Methods.

In late-February of 2010 five 2.5 acre plots in alfalfa fields were grazed by sheep to remove almost all above ground biomass. Two plots were grazed on a farm near the town of Winters, California (Capay silty clay) and four plots were grazed on a farm northeast of Woodland, California (Sycamore silt loam, drained). Each plot was grazed at a density of approximately 40 animal units (AU; 200 sheep) per acre for approximately 2 days. Alfalfa samples were collected from the plots near Winters at 12, 50 and 60 days post-grazing while only one set of samples was collected from the Woodland plots at 50 days post-grazing. The 50 day post-grazing sampling at each farm occurred in mid-April which is a preferred time for the first cutting in Yolo County. Spring rains delayed the first cutting until the end of April at which time samples were collected for 60 days post-grazing. Forage in each plot was sampled by clipping alfalfa from ten one square meter quadrats along two diagonal transects across each plot. Adjacent un-grazed areas were similarly sampled to create grazed and un-grazed sampling pairs. The 12-day forage samples collected at the Winters farm were collected only from un-grazed areas to estimate forage offtake by the sheep (see Figure 1.).

Figure 1. Alfalfa field near Winters on 8-March 2010, eight days post-grazing.

All forage samples were dried for 48 hours at 122^{o} F and individually weighed to estimate alfalfa yields. Dried samples were then pooled by sample date and plot for chemical analyses. Pooled samples were ground to pass through a 1 mm sieve and analyzed using near infrared spectropscopy to determine crude protein (CP), acid detergent fiber (ADF) and neutral detergent fiber (NDF). Means for alfalfa yield and quality parameters were tested for differences using a paired t-test ($P<0.05$).

It is important to note that this investigation was conducted rather spontaneously and without funding. Best efforts were made to take advantage of the opportunity to fit grazed plots into a statistical framework after grazing occurred and to collect as many samples as available resources allowed.

Results and Discussion.

The 50-day post-grazing collection was the only set of samples with sufficient replicates (n=5) to permit statistical comparisons. Although samples were collected from 6 plots, one plot was considered an outlier, most likely due to soil differences, and was excluded from the analyses.

Mean alfalfa yield and quality measurements for the 50 and 60 day post-grazing periods are summarized in Table 1. Alfalfa yield at 50 days post-grazing was significantly lower in the grazed plot by 0.42 tons/acre or 23%. These alfalfa yields would have resulted in gross returns of $184.80 and $240.24/acre for the grazed and un-grazed treatments respectively, a difference of $55.44/acre, assuming a price of $132/ton for premium alfalfa (USDA-AMS, 2010). Crude protein, ADF and NDF were not different between grazed and un-grazed treatments at 50 days post-grazing. Both treatments would be considered premium quality, according to the USDA hay quality guidelines, and would receive an equal market price.

Table 1. Mean alfalfa yield, crude protein, ADF and NDF at 50 and 60 days post-grazing.

	50 days post-grazing†		60 days post-grazing‡	
Parameter	Grazed	Ungrazed	Grazed	Ungrazed
Yield, tons/acre	1.40[a]	1.82[b]	1.70	2.26
Crude Protein %	25.0[a]	24.0[a]	22.1	22.1
ADF %	23.2[a]	26.6[a]	27.7	29.2
NDF %	35.7[a]	40.0[a]	38.3	39.6

[a, b] Means without common letters are significantly different (P<0.05).

† n=5

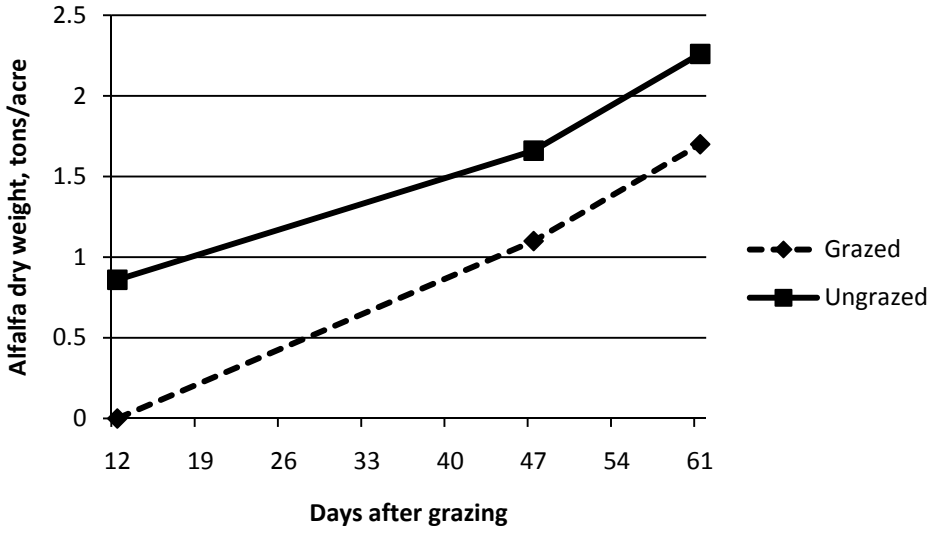
‡ n=2

Although an insufficient number of replicates were available to determine statistical differences between grazed and un-grazed treatments at 60 days post-grazing, the data suggest some trends. Yield differences appeared to have changed very little from 50 to 60 days post-grazing. Un-grazed alfalfa shifted to a lower quality grade of “Good” while the grazed alfalfa remained at the “Premium” level. Using market values for premium and good quality alfalfa in early May 2010 (USDA-AMS, 2010), gross returns would have been $224 and $280/acre for grazed and un-grazed treatments respectively, a difference of $56/acre. Overall the differences in yield and gross returns from 50 to 60 days post-grazing remained unchanged between the grazed and un-grazed treatments.

Yield differences between the grazed and un-grazed alfalfa remained static from 50 to 60 days post-grazing, but earlier compensatory growth did appear to have occurred as shown in Figure 2. The amount of plant material assumed to be removed by the sheep was about 0.86 tons/acre. This difference between the grazed and un-grazed treatments after grazing was reduced to approximately 0.5 tons/acre which persisted to 60 days post-grazing. This may indicate that the loss in yield due to late-winter grazing will not necessarily be equal to the amount of forage removed by the sheep. Once

again, this statement is not statistically supported with our data due to a lack of replicates, and sampling of un-grazed alfalfa should have occurred at the time of grazing.

Figure 2. Alfalfa dry weights for grazed and un-grazed treatments from Winters farm at 12, 50 and 60 days post-grazing.



The apparent costs to the conventional alfalfa grower due to yield reduction by late-winter alfalfa grazing may be offset by the reduction or elimination of dormant herbicide and insecticide applications for weed and weevil control. The costs of these applications in 2008 were estimated at $42/acre (Long et al., 2008), which would reduce monetary losses from late-winter grazing to $13/acre if these applications are eliminated. Organic alfalfa growers do not apply pesticides, but may realize net benefits to grazing by increasing alfalfa yield through improved weed and insect pest control. There may be other costs and benefits to late-winter alfalfa grazing that have yet to be discovered and researched. In addition to pest control, there may be short and long-term benefits to soil quality and crops by integrating sheep grazing into the cropping system. Alfalfa growers may also find a benefit to late-winter grazing by deferring the first harvest of grazed alfalfa fields two weeks which will not compromise quality and may reduce the risk of rain damage on cut alfalfa. Potential costs to the cropping system may result from soil compaction, but previous research has shown that sheep grazing on saturated Yolo loam did not affect soil bulk density or yield (Pelton et al., 1988).

The effects of specifically timed alfalfa grazing applications on weed and insect pests have not been well studied in both conventional and organic systems. Typically fall and early-winter alfalfa grazing is viewed as a source of income for alfalfa growers who receive approximately $0.05/head/day from sheep producers, but rarely is sheep grazing on alfalfa strategically used for pest control and as a means of increasing overall farm productivity. Integrated crop-livestock systems is a holistic farming practice that was deeply rooted in agricultural systems for millennia, but fell out of favor as agriculture became more specialized. Re-integrating livestock into cropping systems could provide greater farm profitability and environmental sustainability (Russelle et al., 2007), but more research and cooperation between crop and animal researchers are needed to develop appropriate integration strategies.

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