SHEEP GRAZING FOR FIELD PEA COVER CROP TERMINATION IN A WINTER WHEAT PRODUCTION SYSTEM

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Impact Statement

Sheep (*Ovis aries*) gained weight while effectively terminating a field pea (*Pisum sativum*) cover crop using either continuous, low stocking density or rotational, high stocking density grazing systems. In a one-year trial, winter wheat yields in plots where cover crops were previously terminated through grazing were equal to those where herbicide or tilled termination approaches were implemented.

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SUMMARY

Targeted sheep grazing represents an alternative to conventional cover crop termination. This study assessed the use of targeted sheep grazing to terminate a field pea cover crop in sequence with winter wheat. These data represent the cropping sequence effect of winter pea on winter wheat in a one-year trial. Our objectives were: 1) to compare the effects of low and high stocking density sheep grazing on efficacy of cover crop termination, sheep live weight gains, and subsequent winter wheat yield, and 2) to compare the efficacy of tillage, herbicide, and grazing methods on cover crop termination and subsequent winter wheat yield.

Ramboulet yearling wethers grazed the cover crop for 32 days (June 16 – July 18, 2013) either in rotational (93 sheep acre^{-1}) or continuous (23 sheep acre^{-1}) grazing systems. Both grazing treatments were equally effective for cover crop termination. Sheep grazing was an effective termination method, based on plant cover measured after termination (averaging 77% dead pea, 1% live pea, 22% bare ground across the two treatments).

Grazing system had no impact on sheep weight gains and sheep from both systems gained an average of 0.37 lbs day^{-1}. There was no difference in subsequent wheat yield (yield evaluated at 12% moisture) between grazing treatments or between cover crop termination methods (grazing, tillage, and herbicide). These results indicated that sheep grazing was effective at terminating a field pea cover crop regardless of the grazing system and that grazing did not impact subsequent wheat yield when compared with mechanical or chemical termination approaches. However, these results represent a 2-yr crop sequence, so results may change with time as the crop rotation matures or with a different legume cover crop.

INTRODUCTION

Cover crops provide valuable services to the agricultural ecosystem including competing with weed species and improving soil properties such as erosion resistance, soil organic matter, and nutrient status, (Mulholland et al., 1976; Azooz, and A' Arshad, 1996; Miller, 2005; Clark, 2007;; Kolb et al., 2010; Moore et al., 2010). Cover crops are usually terminated, or killed, using herbicides or tillage prior to sewing the subsequent crop.

Sheep grazing has been proposed as an alternative method for cover crop termination (Hepworth, 1998). Legumes, which are a favored cover crop because of their biological nitrogen fixation, have the potential to provide quality forage for sheep. For example, field peas contain between 16 and 18% crude protein (Allden and Geytenbeek, 1980; Tan et al. 2013). Integrating sheep into cropping systems that incorporate cover crops may provide a source of high quality forage for sheep production while potentially reducing the need for herbicide application or tillage.

The sustainable integration of sheep and crop production must benefit both producers and the environment, thus a large MSU research effort evaluating the environmental and economic effects of this integration is ongoing. This paper presents results from one phase of the larger study, focusing on the effects of grazing treatment on sheep production, cover crop termination, and wheat yield.

PROCEDURES

We tested the efficacy of grazing for cover crop termination at the Fort Ellis Research Farm, 6 miles east of Bozeman, MT. The cover crop was field pea, a winter pea that was planted September 2012. Two sheep grazing treatments were used. The first treatment was a continuous grazing system with a stocking density of 23 sheep acre^{-1}. The second treatment had a stocking density of 93 sheep acre^{-1}, and the sheep were rotated through strip pastures every four days followed by a 12 day rest period. Sheep grazed from June 16 – July 18, 2013 in both systems. Continuous grazing is a commonly used grazing system that minimizes labor and animal handling stress (Launchbaugh et al. 1978; Owensby 1991; Glindemann et al., 2009). Rotational grazing requires increased handling and labor but may improve animal distribution and increases the uniformity of utilization (Owensby 1991; Launchbaugh and Howery. 2005), which could be desirable in a cropping system setting.

Conventional herbicide terminated plots, tillage terminated plots, and sheep grazed plots were compared for termination (cover) and wheat yield. Tillage and chemical termination took place on June 18, 2013. Chemical termination used a mixture of glyphosate (24 oz acre^{-1}) and dicamba (4 oz acre^{-1}) with a 0.5% by volume HellFire adjuvant. We set a goal for termination as having at least 80% dead pea, 0% live pea, and 20% or less bare ground cover. These termination goals were set to maintain sufficient vegetation cover to protect the soil from erosion. Termination was measured on July 19, 2013. Winter wheat was planted in September 2013, following cover crop termination, and harvested in August 2014.

RESULTS AND DISCUSSION

Both grazing treatments were equally effective at terminating the cover crop (Figure 1). Continuously grazed plots had 77% (SD = 4%) dead pea cover, 2% (SD = 3%) live pea cover, and 22% (SD = 2%) bare ground cover. Rotational Grazing had 77% (SD = 5%) dead pea cover, 1% (SD = 1%) live pea cover, and 22% (SD = 6%) bare ground cover. In fact, sheep grazing was closest to the target termination (Figure 2). Tillage was successful at terminating the pea, but it left more bare ground than the goal, putting the tilled plots at increased erosion risk (Figure 2). Although the herbicide treatment retained excellent soil cover, at the time of sampling for termination the herbicide mixture did not appear very effective on the pea, leaving 73% (SD = 8%) live pea cover (Figure 2).

There was no difference in subsequent wheat yield between grazing treatments (P = 0.91) nor were there any differences in wheat yield among any of the termination methods ($P > 0.13$) (Figure 3).

Continuously grazed sheep had mean average daily gains of 0.34 (SD = 0.037) lbs day^{-1}, while rotational sheep gained 0.40 (SD = 0.013) lbs day^{-1} (Figure 4), with no differences between treatments (p = 0.12).

These results are promising, as we were able to successfully utilize the cover crop as a forage resource while terminating it without the use of tillage or herbicides. The experiment also demonstrated potential economic benefits for sheep producers, as we observed valuable sheep weight gains.

Further research is necessary, as results may vary with different cover crops or from

changing the timing, intensity, or duration of grazing. This is a subset of a longer term study which incorporates sheep grazing into a wheat, lentil, and safflower production system, the results of which will further explain the effects of grazing on cropping systems.

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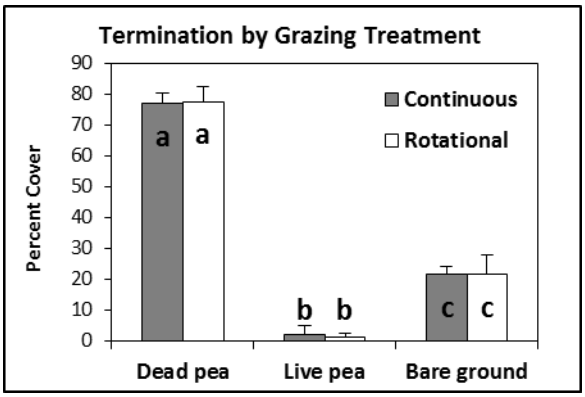

Figure 1: Mean Percent cover by grazing treatment and cover type (error bars = SD, letter codes represent statistical differences ($\alpha = 0.05$) within cover types).

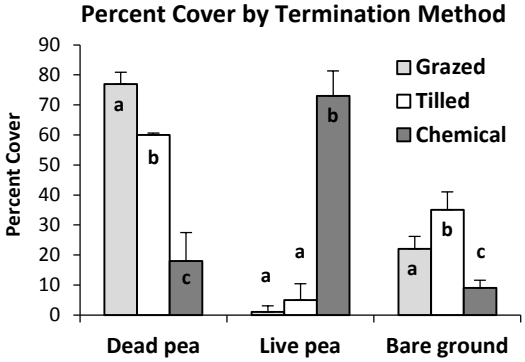

Figure 2: Mean percent cover by termination treatment and cover type (error bars = SD, letter codes represent statistical differences ($\alpha = 0.05$) within cover types).

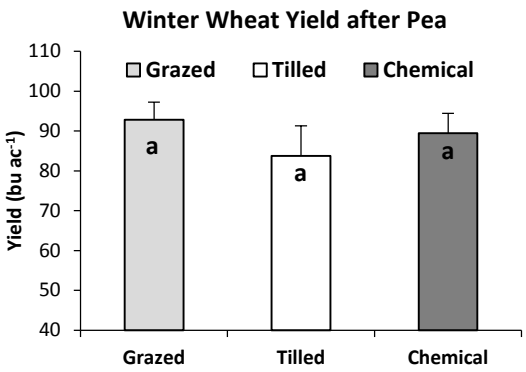

Figure 3. Winter wheat yield after pea cover crop by termination method (error bars = SD, letter codes represent statistical differences ($\alpha = 0.05$)). Wheat yield evaluated at 12% moisture.

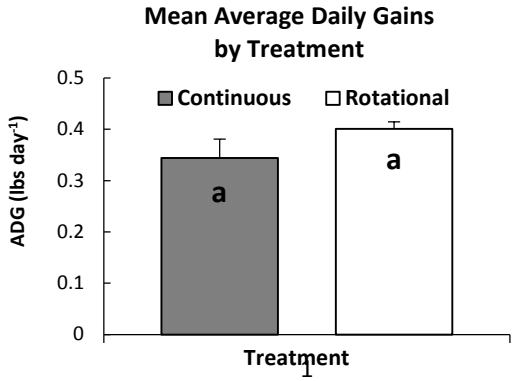

Figure 4: Mean average daily gains in sheep grazing field pea cover crop (error bars = SD, letter codes represent statistical differences ($\alpha = 0.05$)).