Late-Season Grazing Date and Stocking Rate Effect on Persistence and Yield of Pasture Grasses and Legumes

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Introduction

Late-season grazing is a common practice used in the northern U.S. to extend the grazing season and reduce the number of days livestock are fed harvested forages. Most perennial grass and legume species used in this region however, are not well suited to this management strategy. Orchardgrass, timothy, Reed canarygrass, quackgrass, alfalfa, and red clover are key forage species widely used in this region that are heavily impacted by late-season grazing strategies. Reductions in subsequent years’ yield or early stand demise through disease, winter injury, or winter kill is a result of late-season grazing impacts. Livestock managers would benefit significantly from a better understanding of the thresholds of key forage species to fall grazing date in terms of the impacts on yield and persistence. The objective of this study was to determine the impact of four fall grazing date treatments (no fall grazing, September grazing, October grazing, and November grazing), on species composition, total yield, and root characteristics of vegetation following two summer hay harvests.

Materials and methods

Study site

This study was conducted in 2017 and 2018 on approximately 4 ha of private property near Jacobson, MN. The topography of the study site is largely level terrain with slopes less than 1%. The predominant soil types on the site are Cowhorn and Wawina loamy very fine sand.

The vegetation on the site is an agronomical improved mix of introduced species orchardgrass (*Dactylis glomerata*), timothy (*Phleum pratense*), reed canarygrass (*Phalaris arundinacea*), quackgrass (*Elymus repens*), alfalfa (*Medicago sativa*), Kentucky bluegrass (*Poa pratensis*), and red clover (*Trifolium pratense*). The site was previously cropland and was seeded in 2015. The stand was amended for pH and fertilized in the establishment year but has had no agronomic inputs since.

Experiment methods

Treatments were arranged in a split-plot with a 1x3 factorial treatment arrangement with the following factors. Whole plot (1.33 ha): hayed in June and August; Four split plots (0.33 ha each): No fall grazing, grazed in late-September, late-October, or late-November. Whole-plot and split-plot treatments were replicated 3 times.

The haying treatments were applied on June 25, 2017, and August 31, 2017, according to weather conditions suitable for making a 90% dry hay. Vegetation was mowed and windrowed.
with a disc mower to a stubble of 5 cm. Windrows were allowed to dry, raked, and round-baled when moisture was approximately 10% or less. Bales were immediately removed from the field. Vegetation was allowed to regrow following both haying dates. In mid-September, the whole-plot area was fenced using temporary electric fence into 4 separate paddocks representing the split-plot grazing treatments. A grazing-date treatment was randomly assigned to each of the 4 split-plots within each whole plot. The grazing-date treatments were applied according to weather conditions that included periods of rain and snow to avoid complete destruction of grazing paddocks due to excessive hoof traffic and compaction. The treatments were ultimately applied on September 29, 2017, October 25, 2017, and November 23, 2017. Each split-plot grazing treatment was grazed by 15, dry, Angus cows (*Bos taurus*), with a mean weight of 613 kg over a 5-day period.

**Sampling**

Species composition by weight was measured prior to the first whole-plot haying treatment in June 2017. Species composition by weight was measured by clipping all vegetation within 20, 0.32 m² quadrats and sorting by species. Vegetation from each species was then bagged, dried, and weighed. Twenty additional samples were clipped in each whole plot, bagged, dried, and weighed to determine a total standing crop yield estimate. Prior to each split-plot grazing treatment, 20 samples were clipped using the same methodology to determine standing crop yield estimates for the purpose of setting stocking rate at the recommended rate.

Additionally, five, (662.68 cm³) hand-drilled root cores of each of the key species (orchardgrass, quackgrass, and alfalfa) were extracted from each split plot prior to initiation of grazing treatments in late September 2017. Plants of each species were randomly selected and cores were drilled immediately over the crown of the plant. Root cores were bagged in ziploc bags and frozen for storage until data processing began. Cores were thawed and only root material attached to the crown of the plant were analyzed. All other roots within the core were discarded as there was no way to determine the origin of unattached roots. Following separation of root material from the core, root material was scanned for length, surface area, diameter, and volume using a WhinRhizo root scanner (Regent Instruments Inc., Quebec). Following scanning, root material was bagged, dried, and weighed to determine root mass.

The following spring, vegetation was sampled weekly in each split-plot area from May 15 to June 25, 2018, using the methods described above, to determine species composition changes and yield growth curves. Similarly, root cores were taken in each split-plot area on June 25, 2018, using the methods previously described to determine changes to root characteristics of each species.

**Statistical analysis**

Both above ground and below ground data were analyzed as a split plot design with a 1x3 factorial treatment arrangement. Analysis of variance procedures (ANOVA) were conducted using the Statistical Analysis System with the mixed procedure (SAS Inst., 2015). Least
significant difference (LSD) was used to separate means when ANOVA showed significant ($P<0.1$) treatment effects.

**Results and discussion**

Total yield was 37.7% less in October grazed paddocks ($P<0.1$) and 22.2% less in November grazed paddocks ($P<0.1$) than in paddocks that were not fall grazed or were grazed in September (Figure 1). Similarly, yields of orchargrass, alfalfa, red clover, and timothy were all negatively impacted by October grazing. Conversely, quackgrass, Kentucky bluegrass, and non-grass weed species all increased in October grazed paddocks compared to no fall grazing or September grazed paddocks. Alfalfa and timothy were the species most negatively affected ($P<0.1$) by November grazing compared to no fall grazing (Figure 1).

![Figure 1](image_url)

Figure 1. Mean yield (kg ha$^{-1}$) of each species and total yield for Pretreatment in June, 2017 and No grazing control, September grazing, October grazing, and November grazing measured in June, 2018. Differences are analyzed within species and are significant at ($P<0.1$).

Measured root characteristics were not always consistent with above ground results when comparing effect by grazing-date treatments. Mean mass-density of all three species was negatively impacted ($P<0.1$) by the October grazing treatment (Figure 2). Similarly, mean volume density also was negatively impacted by the October grazing treatment (Figure 3), even
though yield of quackgrass increased under October grazing (Figure 1). Similar results were noted for mean surface area – density as all three species experienced a negative response (P<0.1) to October grazing (Figure 4). Furthermore, surface area-density of orchardgrass also was negatively impacted by November grazing (Figure 4). Mean root diameter was negatively impacted (P<0.1) by October grazing for both alfalfa and orchardgrass; but not for quackgrass (Figure 5). This would be expected as quackgrass seemed to flourish under the October grazing treatment. The disparity in results between the above ground and below ground responses are likely due to the different growth habit of quackgrass compared to orchardgrass and alfalfa. Even though the root characteristics of the parent quackgrass tiller was impacted by the October grazing-date treatment, recruitment of additional tillers through the initiation of axial buds on rhizomes did not appear to be affected by any of the fall grazing treatments. Furthermore, the desecration of competing vegetation in response to October grazing in particular appeared to benefit both quackgrass and Kentucky bluegrass tremendously.

Management implications

These data would indicate that grazing regrowth following multiple harvests of hay fields over the summer in the north central U.S., can be extremely detrimental to the key species contained within these fields, ultimately resulting in an overall change in species composition and severely reducing yields. The response of vegetation to November grazing of hay field regrowth is likely subject to annual fluctuations in weather conditions. These data did not show a major response of vegetation to November grazing, likely due to the fact that November of 2017 was mostly cold and vegetation had likely gone dormant. In a warmer October and November scenario, the results may have been much more negative on vegetation. Overall, it appears that grazing hay field regrowth can be reliable achieved in September, but grazing later than September can have extremely negative results until vegetation is dormant in November or later.
Figure 2. Mean mass-density (mg cm\(^{-3}\)) of root material for alfalfa, orchardgrass and quackgrass for pretreatment in June 2017, no fall grazing control, September grazing, October grazing, and November grazing measured in June of 2018. Differences are analyzed within species and are significant at (P<0.1).

Figure 3. Mean volume-density (mm\(^3\) cm\(^{-3}\)) of root material for alfalfa, orchardgrass and quackgrass for pretreatment in June 2017, no fall grazing control, September grazing, October grazing, and November grazing measured in June of 2018. Differences are analyzed within species and are significant at (P<0.1).
Figure 4. Mean surface area-density (mm\(^2\) cm\(^{-3}\)) of root material for alfalfa, orchardgrass and quackgrass for pretreatment in June 2017, no fall grazing control, September grazing, October grazing, and November grazing measured in June of 2018. Differences are analyzed within species and are significant at (P<0.1).

Figure 5. Mean diameter (mm) of root material for alfalfa, orchardgrass and quackgrass for pretreatment in June 2017, no fall grazing control, September grazing, October grazing, and November grazing measured in June of 2018. Differences are analyzed within species and are significant at (P<0.1).