Utilization of novel grazing technologies to implement strip grazing practices within annual grazing systems

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Novel grazing technologies offer strategies to implement intensive grazing management with less labor than traditional fencing. Virtual fencing and automated gate openers effectively managed cattle with similar containment rates to polywire fencing under intensive strip grazing practices. Intensive grazing increased forage utilization, resulting in increased grazing efficiency and increased total stocking rate compared to continuous grazing.

Summary

Intensive grazing strategies offer the potential to enhance grazing efficiency by increasing forage harvest efficiency. Intensive grazing can increase labor and fencing requirements, which may not always be feasible. New technologies, such as virtual fencing and automated gate openers, have become available to aid intensive grazing practices. This study aims to determine the efficacy of virtual fencing and other grazing technologies on the containment of grazing cattle under strip grazing management as well as evaluate the impacts of intensive grazing on forage utilization and stocking rates. An annual forage pasture was established at three locations and divided into four treatments including virtual fencing, automated gate openers, manual poly-wire, and continuous graze. The virtual fencing, automated gate opener and manual poly-wire treatments were divided into eight strips. Cattle locations were recorded by GPS point data and used to determine containment. Forage utilization rates were calculated following the grazing period to determine grazing efficiency. Cattle containment rates did not differ, with 77.5% total contained points by virtual fencing, 77.4% total contained points by automated gate openers and 81.0% total contained points by manual poly-wire. No difference in forage utilization was observed across strip grazing practices; however, forage utilization was greater in manual poly-wire paddocks than continuously grazed paddocks. While stocking rates did not statistically differ between treatments, strip grazing provided an additional 0.5 AUM per acre, equating to an average of 11 more grazing days.

Introduction

Grazing efficiency is driven by reducing waste through enhanced forage harvest efficiency and can increase the total potential stocking rate of pastures. Adoption of intensive grazing practices can lead to increased forage utilization, subsequently raising stocking rates (Davies-Jenkins et al., 2024). Intensive grazing practices, such as strip grazing, subdivide a pasture into smaller allotments and move livestock through each allotment sequentially. These smaller allotments allow more control over forage utilization and promote higher forage use by reducing selectivity and trampling waste (Smart et al., 2010). However, intensive grazing requires increased fencing and labor, which can make implementation a challenge.

Recently, novel technologies have become readily available to livestock producers to reduce labor requirements of intensive grazing. These technologies range from GPS-equipped virtual fencing devices to simpler automated gate openers that offer the potential to make convenient grazing management decisions without increasing labor. Virtual fencing utilizes a GPS-equipped device that is typically worn as a collar on a grazing animal. Pasture boundaries are remotely set within a computer or mobile-based application. When a virtual fencing-equipped animal enters a restricted boundary, an auditory or electrical stimulus is provided to discourage further movement into the restricted boundary. Virtual fencing has been shown to be effective at managing cattle within extensive grazing systems and excluding cattle from sensitive areas (Boyd et al., 2022; Mayer et al., 2025), yet the efficacy

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of virtual fencing technology within small grazing allotments has not been demonstrated. In addition to virtual fencing, automated gate openers have been developed to automate access to paddocks. These devices utilize a timer and retractable latch system to retract electric fence gates at a set interval. These systems still require physical fencing, but they may reduce the labor needed to move cattle into new paddocks.

New grazing technologies have great potential to enhance grazing productivity, yet little has been reported on the impacts of both virtual fencing and automated gate technologies within annual forage systems. Additionally, there is scarce literature comparing intensive and continuous grazing management in annual forage-based systems. The objective of this study is to compare the efficacy of grazing technologies within a strip grazing system and determine the impacts of intensive strip grazing on forage utilization, grazing efficiency and stocking rates.

Materials and Methods

One field composed of an annual forage mix was established each at the Central Grasslands Research Extension Center (CGREC) near Streeter, ND; the Carrington Research Extension Center (CREC) in Carrington, ND; and the Beef Cattle Research and Teaching Center (BCRT) in Fargo, ND. Each field was divided into four paddocks ranging from 4-8 acres and randomly assigned one of four treatments: strip graze with virtual fencing, strip graze with automatic gate opener, strip graze with manual poly-wire gate or continuous grazing. Water and mineral supplement were provided for each paddock. Carrying capacity and forage utilization were determined by clipping eight 5.4 square foot quadrats within each paddock to determine forage biomass both prior to and following the grazing period.

All cattle were fitted with virtual fencing collars and trained to virtual fencing cues for four days before being randomly assigned to a grazing treatment. Cattle assigned to the virtual fencing treatment continued to receive these cues during the experimental period. Virtual fence auditory and electrical boundaries were set at 0-50 ft and 50-300 ft outside the allocated strip, respectively. When cattle under virtual fencing management entered a boundary, the associated cue would be delivered. Cattle assigned to the remaining treatments did not receive virtual fencing cues during the experimental period. Stocking rates were adjusted at each location to sustain approximately one week of grazing duration within each strip. Ten first-calf heifers at CGREC, 11 cows at CREC and 9 first-calf heifers at BCRT grazed each paddock sequentially. Each paddock was grazed independently, and access to the next strip was allowed when utilization reached 60%-75% by visual assessment. GPS location data from the virtual fencing collars were used to determine if cattle were contained within the allocated grazing area. Cattle under virtual fencing management were considered successfully contained when they were inside the allocated strip or auditory boundary.

Results and Discussion

Intensive grazing strategies were equally effective at cattle containment with no difference in containment rates ($P = 0.533$). Containment rates were 77.5% for virtual fencing, 77.4% for automated gate openers and 81.4% for manual poly-wire (Figure 1). The containment rate varied among locations and individual animals. Toward the end of the grazing period within the allocated strip, containment rates often decreased as cattle seek out preferred forages on fence lines, exerting pressure on both virtual fencing and physical fences. Escapes prior to the allocation of the new strip were

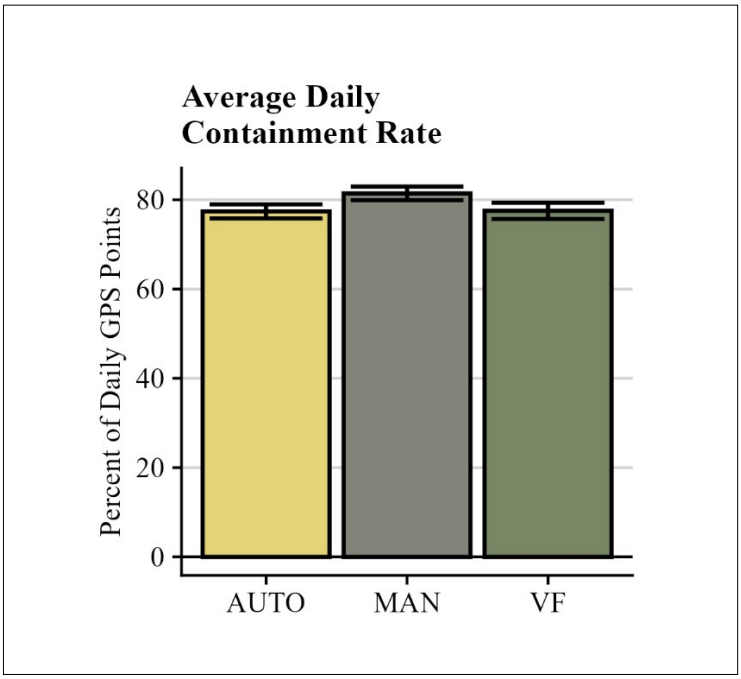

Figure 1. Average daily containment rate of each grazing technology. AUTO = Automated gate opener, MAN = Manual polywire, VF = Virtual fence.

greatest with automated gate openers. The number of virtual fencing cues increased when the virtual fencing boundary moved, as animals learned the new virtual fencing boundaries. Virtual fence containment rates were lower than the 90% or greater efficacy reported by previous literature at two of three locations (Verdon et al., 2021; Boyd et al., 2022). However, all strip grazing containment methods had similar containment rates, indicating this reduction may not be due to the fencing used.

Forage utilization was lower than anticipated across all locations and treatments. The greatest utilization was within the manual poly-wire paddocks at 34%, which differed (P = 0.012) from continuous grazing with the lowest utilization at -15% (Figure 2). Large quantities of trampling waste and regrowth contributed to negative utilization within continuous grazing at some locations. Utilization rates within automated gate opener and virtual fencing paddocks did not differ from manual poly-wire nor continuous grazing at 25% and 14%, respectively. Notably, all strip grazing methods provided an increase in forage utilization. Utilization rates were greater within the allocated strip sections when compared to spatially similar areas within the continuously grazed paddocks. Intensive grazing encourages grazing livestock to consume less palatable portions of the forage, as well as limits trampling when foraging. Jenkins-Davies (2024) reported an 82% increase in stocking rate by strip grazing a stockpiled oat-brassica system. This increase in forage harvest efficiency can be especially useful within annual systems when forage quality and palatability begin to diminish under grazing conditions.

Stocking rate tended (P = 0.094) to be higher in the manual polywire-paddocks compared to continuously grazed paddocks (Figure 2). The average stocking rates across all locations were 2.6 AUM/ac in automated gate paddocks, 2.5 AUM/ac in manual poly-wire paddocks, 2.3 AUM/ac in virtual fence paddocks and 2.2 AUM/ac in continuously grazed paddocks. Grazing duration also differed between locations. At CGREC, cattle in continuous graze and virtual fencing paddocks grazed for 37 days, while automated gate openers and manual poly-wire paddocks grazed for 48 days. All treatments at CREC grazed for 35 days, with grazing ending early due to difficulties containing cattle in all treatments. Unallocated strips in the virtual fencing paddock contained the greatest amount of standing biomass, indicating less access and trampling waste than manual poly-wire or automated gate opener paddocks at CREC. Grazing duration was greatest at BCRT with 49 days in continuously grazed paddocks and 60 days in virtual fence, automated gate opener and manual poly-wire paddocks. Across all locations, grazing duration did not vary between treatments,

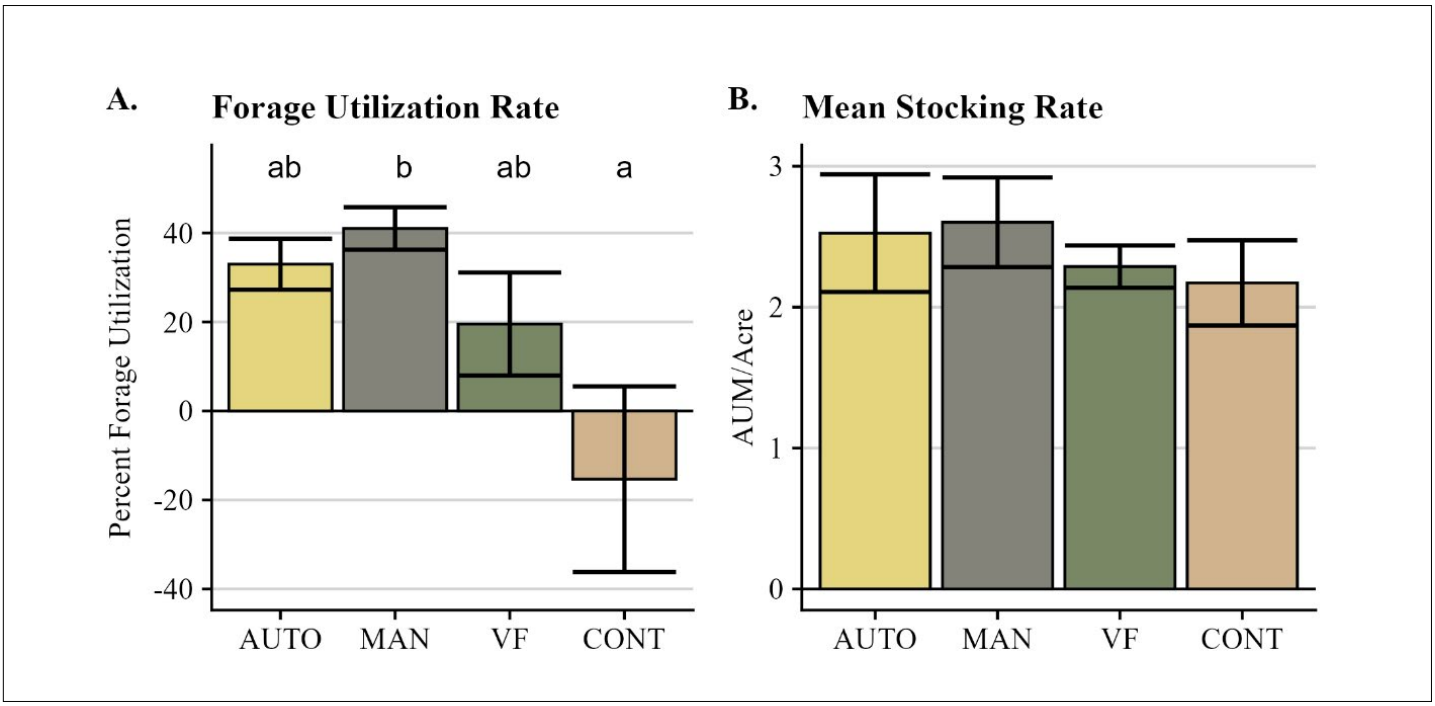

Figure 2. Forage utilization rates (A) and mean stocking rates (B) for each grazing strategy.
[ab]Means not connected by same letter are significantly different ($P \leq 0.05$)
AUTO = Automated gate opener, MAN = Manual polywire, VF = Virtual fence, CONT = Continuous graze.

although intensive grazing provided an additional 11 days of grazing or up to 0.5 AUM/ac compared to continuous grazing.

Both virtual fencing and automated gate openers can serve as effective livestock management tools to implement intensive grazing practices and improve grazing efficiency. Intensive strip grazing can increase forage utilization by reducing preferential grazing and trampling waste compared to continuous grazing practices. While containment rates were lower than previous studies, the overall effectiveness was still comparable to conventional fencing within this study. Escapes within virtual fencing paddocks were often in the form of a "filter" effect, with few animals periodically escaping the allocated strip and returning throughout the grazing period. In comparison, conventional fencing and automated gate openers had larger groups escape and often required additional labor to return the animals to the correct strip. Similar patterns of individual animals repeatedly escaping containment have been reported by previous research (Verdon et al., 2021; Boyd et al., 2022). It is important to consider that no containment method is 100% effective, and complete containment of livestock is not required to attain enhanced grazing efficiency through intensive grazing.

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