Comparison of two low-input cow/calf production systems on temperate grassland

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Abstract

Two systems of grass farming were compared in an eight-year experiment in West Virginia, USA. The grassland consisted primarily of cocksfoot (*Dactylis glomerara* L.), Kentucky bluegrass (*Poa pratensis* L.), tall fescue (*Festuca arundinacea* Schreb.), and red (*Trifolium pretense* L.) and white clover (*T. repens* L.). The objective was to compare two systems of beef cow calf production. The experiment was a randomized complete block with two replicated treatments. The grassland of treatment 1 (system 1) was overseeded with legumes, grazing started 1 wk earlier and continued 1 wk later than treatment 2 (system 2) and calves were allowed to forward creep graze. The hay land of treatment 2 received 56 kg N ha^{-1}, at the start of the growing season. Response was measured as calf weaning weight, hay production, and pre-grazing herbage accumulation. Each treatment/replicate (experimental unit) was assigned 6.5 ha divided into three grassland managements units: pasture, buffer and meadow. Pasture was grazed and not cut for hay. First growth of buffer and meadow was harvested as hay. Subsequently, buffer was grazed, meadow was again harvested, followed by late season grazing. Management units were divided into four paddocks. Animals occupied a paddock for 7 days resulting in 4-week grazing cycles from May to mid-November. Eight cow/calf pairs grazed each treatment/replicate (stocking rate 1.23 cow calves ha^{-1}). Calves, born in March, were weaned in late September. System 1 calves gained 1.18 kg dy^{-1} ($P < 0.04$ SE=0.01) compared with those on System 2 which gained 1.14 kg dy^{-1}. Annual hay production on System 2 was 5784 kg ha^{-1}, significantly more than on System 1 ($P<0.01$ SE=107). However, in System 1 extending the grazing season reduced the amount of hay required annually by 1680 kg ha^{-1}. System 1 hay had a greater proportion of legume (9 vs. 3%, $P<0.01$ SE=0.5) and a lesser proportion of grass (75 vs. 85%, $P<0.01$ SE=0.7) than those of system 2.

Introduction

The hill lands of the eastern United States are among the largest forage resources in the USA (Van Keuren, 1976). The largest contiguous hill land in this region encompasses the Appalachian Mountains. Pastures in the Appalachian Highlands are generally located on steep, rough ground. The predominant forage species are coolseason grasses, legumes and forbs, with many species combined in naturalized pasture. The majority of livestock producers in this area graze ruminants on these pastures and are involved in cow/calf or yearling cattle production. These naturalized pastures in general require little financial inputs to maintain, are generally of greater quality than most monoculture pastures and are often the only agricultural alternative for sites with soil and slope limitations. The predominate forage species in these pastures are Kentucky bluegrass (*Poa pratensis* L.), cocksfoot (*Dactylis glomerara* L.), tall fescue (*Festuca arundinacea* Schreb.), and white clover (*Trifolium repens* L.). Native soil pH varies between 4.8

and 5.3 and the most limiting plant nutrients are N and P. Much of the hill lands of Appalachia is too steep for making hay. Since the area suitable for hay is small it is often the factor limiting herd size. Usually, areas managed as meadow are not fenced and grazed.

Previous research has been conducted in the region to compared different cow-calf production systems. Bryan, Prigge and Burton (1986) compared a system representing what most beef cow/calf producers use (system 1), continuous stocking of pasture, meadow harvested twice as hay and grazed in the autumn, with one (system 2) including modifications based on results to date of component research and which it was considered farmers could easily adopt. An area of meadow was included in both Systems because hay is needed for winter feeding the herd. System 2 (rotational stocking, forward creep grazing, and overseeding of pasture with clover, and autumn grazing of meadow overseeded with tall fescue) produced heavier weaned calves (8% more per animal and 25% more per acre), due to a greater stocking rate than system 1. It was observed that system 2 had greater economic feasibility than system 1 due to greater value of the calves.

In a second experiment, two systems were compared as described by Bryan et al. (2000). In summary, treatments were assigned to the same area of grassland, where in system 1, 60% of the areas was grazed and 40% meadow, harvested twice for hay and then grazed. The area of system 2 was 40% pasture, 30% meadow (harvested twice, followed by late autumn grazing) and 30% buffer, which was harvested once for hay and then included in the pasture area and grazed for the remainder of the season. Stocking rate was greater on system 2, on the assumption that rotational grazing would result in more harvested forage. While cow and calf performance did not differ between the two systems, calf gain ha^{-1} was greater, hay production and economic return was greater in system 2 than system 1.

Materials and Methods

The experiment was conducted at the West Virginia University Farm, Reedsville WV (39.53N 79.83W, Elev 1811) from 1999 to 2007. The experimental design was a randomized complete block with two farming system treatments and two replicates. System 1 was overseeded with red (*T. pretense* L.) and white clover, the grazing season was 2 wk. longer than system 2 and calves were allowed to forward creep-graze. System 2 buffer and meadow managements were fertilized with 56 kg N ha^{-1} prior to first hay harvest (early June). Thirty-two beef cow/calf pairs of Angus Hereford breeding were randomly assigned to four experimental units (8 pairs per experimental unit). Calves were born in March and weaned and removed in September (end of Cycle 4). Each treatment consisted of 6.50 ha of grassland divided into three grassland managements units: 1.95 ha (30%) meadow, harvested twice as hay followed by late season grazing, 1.95 ha (30%) buffer, harvested once as hay followed by grazing and 2.60 ha (40%) as pasture, grazed from May to early November (Figure 1). Management units to be grazed were divided into four paddocks, rotationally stocked with 7 d grazing period and 21 d resting periods. After three grazing cycles during which only the pasture management unit was grazed (May, June and July), the buffer was included in the grazed area (Figure 1), in Cycle 4 and 5 the buffer was included in the grazed area, while the meadow was also included in the grazed area in Cycle 6.

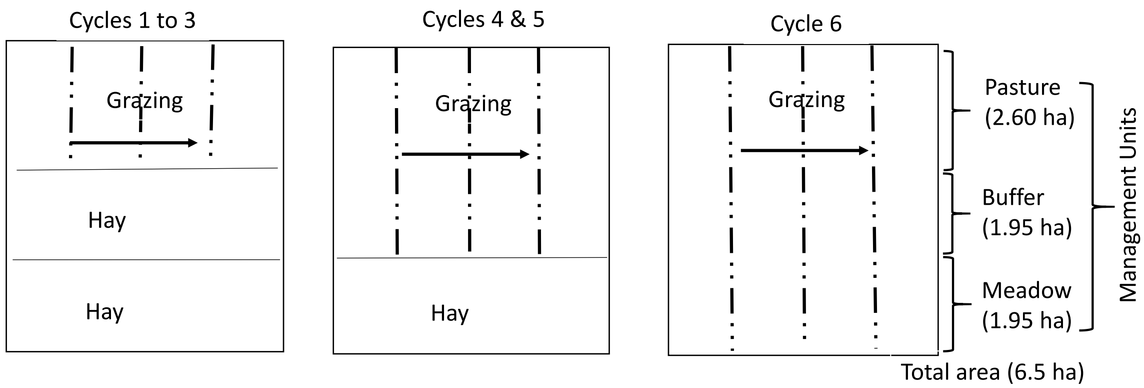

Figure 1. Diagrammatic representation of the field layout of one treatment/replicate.

In early April 1999, all units of system 1 were overseeded with red and ladino clover. In subsequent years, one of the four paddocks of each unit was over-seeded in early April each year, such that in four years all four paddocks had been over-seeded with clovers. Animals started grazing in late April when sward height reached approximately 5 cm. During the first week they grazed the over-seeded paddocks of pasture, buffer and meadow as one paddock. In addition, the grazing season for the cows (calves had been weaned and removed) continued to mid-November. This last paddock of pasture, buffer and meadow was the one overseeded the following spring. Calves were allowed to forward creep graze into the next paddock to be grazed which included the buffer paddock in cycle 4. Calves were weaned and removed at the end of Cycle 4.

Nitrogen as urea was applied at the rate of 56 kg ha^{-1} at the start of the growing season (early April) to meadow and buffer managements of system 2. Grazing started one week later and ended one week earlier than System 1. Based on our experience with extending the grazing season we expected the grassland overseeded with legume to accumulate more herbage (Prigge et al., 1993).

Soil amendments were made annually to those paddocks, the soil test result of which was below pH 5.8, 67 P kg ha^{-1} and 196 kg ha^{-1} Borax ($Na_2B_4O_7$) was applied in year 1 at the rate of 13 kg ha^{-1}. Transect lines were established in the paddocks for collection of sward height and soil samples. Sward heights were taken before grazing according to methods of Rayburn and Rayburn (1998). Hay production was determined by clipping short strips to a 1 cm stubble height. Botanical composition was determined by hand separation of the clipped samples. Herbage mass was determined from pre-grazing sward heights. Prediction equations were developed from regressions of paired samples of sward height and herbage mass from approximately 50 field samples. Cows and calves were weighed at the initiation of the grazing season and every 28 d thereafter. The grazing season ended when cows were removed in November.

Data were analysed using Proc Mixed and Proc GLM models (SAS Inst. Inc., Cary NC) as a randomized complete block with 2 replications. Year and rotation were analyzed as repeated measurements for herbage mass analysis. Replicate within system was the experimental unit.

Results

Average annual starting and ending cow liveweights were 606 kg and 684 kg, respectively and there was no significant difference between systems. Calf average daily gain was greater, 1.18 kg dy^{-1} ($P < 0.04$ SE=0.01), in system 1 compared to those in system 2 (1.14kg ha^{-1}). Average weaned weight was 235 kg calf $^{-1}$ and 190 kg ha^{-1} with no difference between systems. More hay was produced on system 2 (P<0.01 SE=107) with an average of 5784 kg ha^{-1} harvested from system 2 meadows compared to 4751 kg ha^{-1} from system 1. Hay harvested from system 1 had a greater proportion of legumes (9 vs. 3%, P <0.01 SE 0.5) and forbs (12 vs. 8%, P <0.01 SE=0.59) and a lower proportion of grass (75 vs. 85%, P <0.01 SE 0.7) than hay from system 2.

Discussion

Performance of cows was not affected by system, and cows have been reported to regain weight lost during the suckling season after calves are weaned (Bryan, et al., 2000). Greater calf gains on system 1 may have been due to forward creep grazing. Pastures of both systems had proportions of legumes we consider good (approximately 10%). Greater proportion of legumes in system 1 hay did not affect calf performance. However, it may be explained by legume overseeding. Although use of N fertilizer in system 2 resulted in greater hay production than system 1, the extension of the grazing season by 2 wk. reduced the amount of hay required for overwintering the cows on system 1 by approximately1680 kg. We conclude that both production system, when well-managed, will be productive and choice of system to use will also depend on costs of inputs such as N, overseeding, and fencing (of meadows), etc. While not a variable in this experiment, we suggest that stocking rate will affect differences between cow/calf production systems. Ultimately choice of production system will be based on producer preferences and economics, particularly if the primary limiting factor to grassland production is conserved forage needs.

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