Growth performance by heifers grazing annual ryegrass pastures fertilized with nitrogen or overseeded with crimson, ladino, or both crimson and ladino clovers during spring: Three-year summary

B. E. Briggs, T. G. Montgomery, K.P. Coffey, D. Philipp, P. B. Francis, J.D. Caldwell, W. A. Whitworth, and A. N. Young

Story in Brief

Interest in substituting legumes in place of nitrogen fertilizer in beef cattle grazing systems has increased with rising fertilizer prices. The objective of this study was to compare forage production and beef cattle gains from annual ryegrass pasture fertilized with nitrogen or overseeded with legumes. Gelbvieh × Angus crossbred heifers (n = 120; 581.3 ± 100.57 lb initial body weight (BW)) were assigned to 1 of 8, 5-acre pastures in the spring of each of the three years of study between 2009 and 2011. All pastures were overseeded with ‘Marshall’ annual ryegrass, and were not seeded with any clover (commercial nitrogen applied) or overseeded with ‘Dixie’ crimson, ‘Osceola’ ladino, or a combination of crimson and ladino clover (CL). Heifers were turned out between January to March and grazed pastures until early to mid-May. Total body weight gain and average daily gain was not different (P > 0.05) among treatments; however, number of grazing days was higher for nitrogen treated pastures versus pastures that contained legumes (P < 0.01). It appears that with an equal number of grazing days, clovers may not be able to totally eliminate the need for fertilizer, but they may be able to reduce the fertilizer requirement.

Introduction

Natural gas is the primary resource used to produce ammonia which in turn is either directly applied as a fertilizer or used as a precursor for many common N fertilizers. Therefore, a shift in the price of natural gas will affect ammonia and N fertilizer cost. A report from the USDA-Economic Research Service (USDA, 2011) stated that ammonia prices paid by farmers increased from $227 per ton to $521 per ton between 2000 and 2006. The increased cost of conventional fertilizers encourages producers to look at lower cost alternatives. Legumes have the ability to fix atmospheric N in conjunction with a symbiotic relationship with Rhizobia bacteria and therefore reducing the need for external N input. The primary goal of this study was to monitor forage and animal production from sod-seeded annual ryegrass either fertilized with N, or overseeded with crimson clover, ladino clover, or both crimson and ladino clover.

Materials and Methods

Gelbvieh × Angus crossbred spring-born heifers (n = 120; 581.3 ± 100.57 lb initial body weight (BW)) from the University of Arkansas Livestock and Forestry Research Station near Batesville, Ark. were transported approximately 225 miles to the Southeast Research and Extension Center (SERC) in Monticello, AR. Heifers remained as a group upon arrival at SEREC and were put on a dormant bermudagrass pasture and given bermudagrass hay ad libitum. The groups of heifers were then assigned randomly to 1 of 8, 5-acre pastures. Each year of the study, a different set of heifers were used. The stocking rate was 1 cow/acre.

The experimental pastures consisted of common bermudagrass (Cynodon dactylon) that was sod-seeded mid-September by broadcasting with 30 lb/acre (actual seeding rate) of annual ryegrass (Lolium multiflorum cv. Marshall) after a light disking. The pastures were dragged to smooth the surface and improve the soil to ryegrass seed contact. After dragging, 2 pastures each were overseeded by broadcasting with either 9.8 lb/acre (pure live seed; PLS) of crimson clover (C; Trifolium incarnatum cv. Dixie), 4.5 lb/acre (PLS) of ladino clover (L; Trifolium repens cv. Osceola), or both crimson and ladino clover (CL; 9.8 lb and 4.5 lb/acre, respectively). The seeding rates for the ladino and crimson mixed pasture were not halved when combined in order for each species to fully represent its respective grazing period. Soil fertility was adjusted if needed according to soil test recommendations.

On November 3, 2008, control treatments received 300 lbs/acre of 19-19-19 (57 lbs/acre actual N). The following day, November 4, 2008, legume treatments received 200 lbs/acre of 0-23-30. February 23, 2009, control treatments received 150 lbs/acre of 34-0-0 (51 lbs/acre actual N) as spring application. The same day, legumes also received N at the amount of 60 lbs/acre of 34-0-0 (20 lbs/acre actual N). It was recognized at this point that without early-spring fertilization of legume treatments, the grazing starting date in these pastures and therefore grazing days among treatments would likely differ to an extent which would make treatment comparisons unrealistic. The fertilizer quantities applied were considered large enough to initiate ryegrass biomass production yet small enough to not limit N fixation rates substantially.

This fertilizer practice was continued during the second and third years of the experiment. On November 9, 2009, control treatments received 300 lbs/acre of 19-19-19 (57 lbs/acre actual N). Legume treatments received 300 lbs/acre of 6-24-24 (18 lbs/acre actual N) the same day. On March 4, 2010, control treatments received 180 lbs/acre ammonium nitrate (61 lbs/acre actual N), and legume treatments received 100 lbs/acre ammonium nitrate (34 lbs/acre actual N). A quantity of 1.5 tons/acre of lime was also applied in 2009. For the third year of study, legume plots were fertilized with 300 lbs/acre 6-24-24 (18 lbs/acre actual N) and the control paddocks were fertilized with 300 lbs/acre 19-19-19 (57 lbs/acre actual N) November 10, 2010.

During the first year of the study, cattle were stocked on control pastures January 23, 2009. However, legume/ryegrass treatment pastures were not stocked until March 6, 2009 due to a lack of available forage. Heifers remained on their respective pastures until May 11, 2009. Remaining forage biomass was cut for hay on May 27, 2009. Forage from these pastures was cut on May 27, 2009. Forage from these pastures was cut on May 27, 2009.
the second year of study, the randomization structure of treatments remained. Heifers were again rotated between cells and weighed at the same intervals used in the first year. Heifers were stocked on their respective pastures on March 15, 2010 when forage biomass was great enough to begin grazing. In 2010, grazing days were possibly affected across all pastures due to heavy damage by grazing wildlife early in 2010. Cattle remained on their respective pastures until May 12, 2010. The third year of study was managed in the same manner as the first and second. During 2011, cattle were stocked February 17 and were removed May 3.

Calf BW, forage production, and species composition data were analyzed using PROC MIXED of SAS (SAS Inst., Inc., Cary, N.C.). The original pasture group was used as the experimental unit for all analyses.

**Results and Discussion**

Initial BW, ending BW, total BW gain, and average daily gain (ADG) did not differ among treatments \((P > 0.1; \text{ Table 1})\). However, grazing days were significantly higher \((P < 0.01)\) for control pastures than pastures that contained legumes. This is primarily due to a delay in grazing during the first year (2009) when growth in legume pastures lagged behind. The fertilizer regime was therefore changed during following years to reduce these differences. Thus far, it appears that legumes may offset fertilizer costs, but this may be difficult during spring grazing. The time available for legume growth is relatively short between broadcasting in Sep/Oct and start of grazing early in the year. Thus, the amount of N fixed will be small, too. A positive result from this study is that ADG was not different across treatments \((P > 0.05)\). However, it is possible that these numbers are more related to annual ryegrass which also has a relatively high nutritive value. Conversely, ADG did not change during the summer months of 2009 and 2010 (data no shown) when cattle grazed primarily bermudagrass. A detailed economic analysis is currently underway to determine if clover seed and planting costs would offset or even cost less than the incurred costs in N fertilizer.

**Implications**

Producers may use legumes and reduced amounts of commercial N in a pasture system to obtain similar animal production in comparison to pastures without legumes fertilized with traditional N rates. However, increased management requirements with respect to legume establishment and persistence need to be taken into consideration when a long term substantial reduction of synthetic N fertilizer is the goal.

**Literature Cited**


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**Table 1. Growth performance by heifers grazing sod-seeded annual ryegrass pastures with either no legumes or overseeded with crimson, ladino, or both crimson and ladino clovers spring 2009-2011.**

<table>
<thead>
<tr>
<th></th>
<th>Nitrogen</th>
<th>Crimson</th>
<th>Ladino</th>
<th>Crimson + Ladino</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial wt., lb</td>
<td>565</td>
<td>586</td>
<td>584</td>
<td>589</td>
<td>53.3</td>
</tr>
<tr>
<td>End wt., lb</td>
<td>780</td>
<td>768</td>
<td>761</td>
<td>768</td>
<td>43.7</td>
</tr>
<tr>
<td>Total study gain, lb</td>
<td>215</td>
<td>182</td>
<td>178</td>
<td>179</td>
<td>18.2</td>
</tr>
<tr>
<td>Avg. grazing days/acre</td>
<td>79(a)</td>
<td>66(b)</td>
<td>66(b)</td>
<td>66(b)</td>
<td>5.8</td>
</tr>
<tr>
<td>ADG, lbs/day</td>
<td>2.7</td>
<td>2.8</td>
<td>2.7</td>
<td>2.7</td>
<td>0.36</td>
</tr>
</tbody>
</table>

\(a\)Within a row, means that do not have a common superscript letter differ, \(P < 0.05.\)
ADG = average daily gain.