Story in Brief

The objective of this research was to determine the impact of alfalfa or clover additions to bermudagrass pastures on performance of growing calves and pasture carrying capacity compared to commercial N. In October 2008, bermudagrass (Cynodon dactylon [L.] Pers.) pastures (n = 8; 2 acre) were interseeded with 12 lb red clover/acre (Trifolium pratense, cv. Morningstar, Cal/West Seeds, Woodland, CA) and 3 lb/acre ladino white clover (Trifolium repens, cv. Regal Graze, Cal/West Seeds) or with 25 lb alfalfa/acre (Medicago sativa, cv. PGI 459, Producers Choice, Woodland, Calif.). Due to stand losses in alfalfa pastures, the 4 established alfalfa pastures were destroyed in fall 2009 and alternate pastures were established to another alfalfa variety selected for grazing under conditions in the southern United States (cv. Rebel, Producers Choice, Woodland, Calif.). The 12 bermudagrass pastures received 0, 50, or 100 lb N/acre as ammonium nitrate. Over 3 years, growing beef steers (n = 431, body weight = 542 ± 73 lb) grazed pastures in this put and take experiment in which each year four steers were selected for each pasture to measure animal performance and additional steers were added or removed in order to maintain similar forage allowance among pastures. Grazing was initiated in mid April or May in alfalfa and clover pastures each year and in May in fertilized bermudagrass pastures. Data were analyzed as a completely randomized design with the mixed procedure of SAS. Single $df$ contrasts were used to determine the linear N fertilization rate effect, the effects of alfalfa and clover vs. each N fertilization rate, and the alfalfa vs. clover comparison. Stand counts of initial alfalfa pastures decreased from 34% in May 2009 to 15% in October 2009, but alfalfa stands in replacement pastures remained between 45% and 55% through 2010 and 2011. Clover pastures maintained stands of 38% to 55% over the 3 year period. Daily gains increase linearly ($P < 0.01$) with increasing N rate. Daily gains of clover and alfalfa pastures did not differ ($P = 0.64$) from 50 lb N rate, but were less ($P < 0.01$) than 100 lb N rate. Gains of clover and alfalfa steers did not differ ($P = 0.59$). Body weight gain/acre increased linearly ($P < 0.01$) with increasing N rate. The legumes produced more ($P < 0.01$) bodyweight gain/acre and grazing-days/acre than all N fertilizer rates. Grazing-d/acre of alfalfa was greater ($P = 0.05$) than clover, yet bodyweight gain/acre did not differ ($P = 0.54$).

Introduction

Increasing costs of production are causing beef producers to look at alternative production systems and production practices (Rouquette and Smith, 2010). From 2002 to 2008, the cost of synthetic N has increased by over 300%, contributing to elevated costs of production and cost of bodyweight gain (Rouquette and Smith, 2010). The inexpensive N fertilizers of the 1950s and 1960s led to replacement of grass-clover pasture combinations with more productive N fertilization of grass pastures (Rouquette and Smith, 2010). With increasing N fertilizer cost, economic conditions are present for a shift back to legume inclusion in pasture systems. Although estimates vary depending on a multitude of conditions, clovers contribute from 20 to over 200 lb N/acre to pastures (Knight, 1970), but direct transfer of N from legumes to grasses growing in the same season is extremely low (Morris et al., 1990). The objective of this research was to determine the effects of white and red clover or alfalfa additions to bermudagrass pastures on steer performance in relation to a range of N fertilization rates.

Materials and Methods

This research took place on 40 acres of bermudagrass pasture located at the University of Arkansas Livestock and Forestry Research Station near Batesville in northeast Arkansas (35°50’ N, 91°48’ W). The study site consisted of Peridge silt loam soil which is a deep well-drained upland soil with moderate fertility. In October 2008, bermudagrass (Cynodon dactylon [L.] Pers.) pastures (n = 8; 2 acre) were interseeded with cool-season legumes. Four pastures were seeded with 12 lb red clover/acre (Trifolium pratense, cv. Morningstar, Cal/West Seeds, Woodland, Calif.) and 3 lb ladino white clover/acre (Trifolium repens, cv. Regal Graze, Cal/West Seeds). Four pastures were seeded with 25 lb alfalfa/acre (Medicago sativa, cv. PGI 459, Producers Choice, Woodland, Calif.). Due to stand losses in alfalfa pastures, the 4 established alfalfa pastures were destroyed in fall 2009, and alternate bermudagrass pastures were established to another variety selected for grazing under conditions in the southern United States (cv. Rebel, Producers Choice, Woodland, Calif.). The remaining 12 bermudagrass pastures received 0, 50, or 100 lb N/acre as ammonium nitrate ($n = 4$ pastures per N rate) in split applications (one-half of total N per application) in May and July each summer. Over 3 years, growing beef steers (n = 431, bodyweight = 542 ± 73 lb) grazed pastures in this put-and-take experiment in which each year four steers were selected for each pasture to measure animal performance and additional steers were added or removed in order to maintain similar forage allowance among pastures. Steer bodyweight gain/acre were calculated based on daily gains of 4 tester animals in each pasture and the total number of grazing days of grazers and testers per acre. Grazing was initiated in all pastures on May 29, 2009 in year 1 and on May 25 in year 2. In year 3, alfalfa pastures were ready to graze on April 14 and clover pastures were ready to graze by April 29, while grazing of bermudagrass pastures was initiated on May 11, 2011. Stand counts of the initial alfalfa pastures decreased from 34% in May, 2009 to 15% in October 2009, but alfalfa stands in replacement pastures were replaced at year four steers were selected for each pasture to measure animal performance and additional steers were added or removed in order to maintain similar forage allowance among pastures. Grazing was initiated in mid April or May in alfalfa and clover pastures each year and in May in fertilized bermudagrass pastures. Data were analyzed as a completely randomized design with the mixed procedure of SAS. Single $df$ contrasts were used to determine the linear N fertilization rate effect, the effects of alfalfa and clover vs. each N fertilization rate, and the alfalfa vs. clover comparison. Stand counts of initial alfalfa pastures decreased from 34% in May 2009 to 15% in October 2009, but alfalfa stands in replacement pastures remained between 45% and 55% through 2010 and 2011. Clover pastures maintained stands of 38% to 55% over the 3 year period. Daily gains increase linearly ($P < 0.01$) with increasing N rate. Daily gains of clover and alfalfa pastures did not differ ($P = 0.64$) from 50 lb N rate, but were less ($P < 0.01$) than 100 lb N rate. Gains of clover and alfalfa steers did not differ ($P = 0.59$). Body weight gain/acre increased linearly ($P < 0.01$) with increasing N rate. The legumes produced more ($P < 0.01$) bodyweight gain/acre and grazing-days/acre than all N fertilizer rates. Grazing-d/acre of alfalfa was greater ($P = 0.05$) than clover, yet bodyweight gain/acre did not differ ($P = 0.54$).
and 55% at the end of grazing in 2011. Clover pastures had stand densities of 38%, 43%, and 55% at the end of grazing in 2009, 2010, and 2011, respectively.

This study was analyzed as a randomized complete block design with a split-plot using the Mixed Procedure of SAS (SAS Institute, Cary, N.C.). Year was considered a random effect. Pasture was considered the experimental unit. Single df contrasts were used to determine the linear N fertilization rate effect, the effects of alfalfa and clover vs. each N fertilization rate, and the alfalfa vs. clover comparison.

Results and Discussion

The performance of steers grazing bermudagrass pastures with N fertilization or interseeded with clovers or alfalfa is presented in Table 1. As N fertilization rate increased, average daily gain (ADG) of steers increased in a linear fashion ($P < 0.01$), increasing from 1.35 lb/d for steers grazing unfertilized pastures to 1.80 lb/d for steers on the pastures fertilized at the 100 lb/acre rate. Daily gains of steers grazing alfalfa and clover pastures did not differ ($P \geq 0.59$) from each other or the 50 lb N/acre rate averaging 1.59 lb/d, but were greater ($P < 0.01$) than ADG of steers on unfertilized pastures. Steers grazing pastures fertilized with 100 lb N/acre gained 0.21 lb/d more ($P < 0.01$) than steers grazing legume pastures. Bodyweight upon removal from pastures was, as observed with ADG, increased linearly with increasing N fertilization ($P < 0.01$). Bodyweight when steers were removed from pastures did not differ ($P \geq 0.12$) between alfalfa and clover pastures or between legume pastures and 50N or 100N fertilization rates.

As would be expected, total bodyweight gain per acre was increased ($P < 0.01$) linearly with increasing N fertilization rates, but surprisingly there was no change ($P = 0.42$) in grazing-day per acre with increasing N fertilization. The lack of increase in grazing days may be due to drought conditions that have been encountered during 2-years of the 3-year study. Due to slightly longer grazing season and greater stocking rate during the early grazing season, alfalfa and clover pastures had greater ($P < 0.01$) grazing-days/acre than all N fertilization rates. Bodyweight gain/acre was thence greater ($P < 0.01$) for legume pastures compared with all N fertilization rates. Steer grazing-days/acre were greater ($P = 0.05$) for alfalfa than clover pastures yet bodyweight gain per acre did not differ ($P = 0.55$).

Using regression analysis on the bodyweight gain per acre observed at the varying N fertilization rates indicated that for each lb of N fertilizer, bodyweight gains were increased by 1.25 lb/acre. Alfalfa pastures produced the equivalent gain/acre of 185 lb N/acre and clovers produced the equivalent of 168 lb N/acre. Although outside of the range of data the N response curve was determined, the N equivalent observed with legume indicates that legumes can effectively replace high rates of N fertilizer.

Implications

Nitrogen fertilizer can effectively be replaced by either clovers or alfalfa in bermudagrass pastures for growing beef steers. Alfalfa variety selection is an important factor to consider when utilizing this legume for grazing cattle. Varieties of alfalfa selected under similar management and growing conditions would be expected to persist longer than varieties selected for hay production in other environments. Species of clovers must be selected to match both the site and growing season of main use and no one species of clover would be expected to produce throughout the entire grazing season.

Literature Cited

Table 1. Effect of alfalfa or white and red clovers interseeded into bermudagrass pastures compared with N fertilization on performance of growing beef steers.

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