Forages and Pastures: Symposium: Forage Management Strategies of Offset High Input Costs

299 Effects of biological N fixation and nutrient cycling on stocking strategies for cow-calf and stocker programs. F. Rouquette, Jr.* and G. Smith, *Texas AgriLife Research, Overton*.

Pasture and beef production costs for fuel, fertilizers, feed, and seeds increased from 2 to 3-fold between 2003 and 2009. With primarily grass-based pasture systems for cow-calf and stocker operations in the southeastern US, increased costs of nitrogen (N) fertilizer has caused shifts in management and stocking strategies. Incorporation of biological N-fixing clovers and other legumes into pastures presents challenges with seasonal and total DM production, sustainability of forage species, and maintenance of stocking rates. Nutrient cycling via animal excreta is the primary process of transferring N fixed in plants back to the soil for subsequent use by forages. Bermudagrass (BG) pastures at Overton which have received N and overseeded with ryegrass vs no N and overseeded with clovers (Trifolium sp.) have been stocked at three intensities with cows and calves for 24 years, 1985-2009, to assess forage species composition, cow-calf performance, and gain per unit area. Without N fertilization on Coastal Plain soils, bahiagrass invasion and an increase in BG ecotype diversity occurred at high stocking rates; however, at low stocking rates, both common and Coastal BG stands were maintained at about 80% of the pasture composition. At low stocking rates of 2.0 to 2.5 cow-calf units per ha, calf ADG was similar at 1.25 kg d^{-1} with gains of 450 kg ha^{-1} for N + ryegrass and 360 kg ha^{-1} for no N + clover. Angus x Brahman heifers (245 kg) had similar ADG of 1.3 kg d^{-1} stocked at 3.7 hd ha^{-1} or 0.6 kg d^{-1} when stocked at 10 hd ha^{-1}. Gain per unit area ranged from 970 kg ha^{-1} at 10 hd ha^{-1} to 580 kg ha^{-1} at 3.7 hd ha^{-1}. Pasture costs per kg gain must also include phosphorus, potassium, lime, etc. for sustained forage production. Management strategies which offset high input costs must be attentive to stocking rates, fertilizer regimens, forage utilization, hay requirements, and efficiency of animal production parameters.

Key Words: N-fixation, nutrient cycling, stocking strategies

300 Effects of N fertilization and supplementation strategies on forage intake, dietary selection, and performance of growing beef cattle. S. A. Gunter*, T. L. Springer, and J. A. Bradford, *USDA-ARS, Southern Plains Range Research Station, Woodward, OK*.

The N cycle on pasture is the movement of N through several pools found in the pastoral system. Except on a global scale, N cycles are generally not closed; that is, there are inputs to and losses from the system. Nitrogen is the most perplexing of all nutrients; moving in a variety of pathways-both biological and chemical; it has several oxidative states, can exist as a gas, a dissolved cation or anion, a precipitated salt, or a dissolved or solid organic molecule. There are 6 major pathways of N loss in grazed land: NH_3 volatilization, denitrification, wind and water erosion, NO_3^- leaching, and animal losses (export). Fecal pats of cattle contain the equivalent of 560 to 1,120 kg of N/ha, but plant recoveries of N from these pats rarely exceed 30%. Nitrogen fertilizers have been the tool most easily manipulated to affect herbage quality and available mass to grazing ruminants. Recently, the price of N fertilizers increased to a point where graziers are questioning the economics of adding N via chemical fertilizers. Nitrogen fertilizers increase herbage mass production, thereby impacting the optimal stocking rate for maximal net-return per unit of land. The net return of the stocker cattle enterprise is functions of ADG, BW gain/ha, production cost, and revenues. Supplementation practices that decrease herbage DMI can increase the carrying capacity of a pasture without placing greater demand on the herbage mass, except through trampling, and accelerate the N cycle. Supplements transport N into the pasture N cycle from an outside source and can make a significant contribution to nutrient pool. Nitrogen in excreta generated from supplemental grain, hay, silage, and product feeds enter the system and increase the quality and quantity of forage produced. Nitrogen in feces is mainly in organic forms, with one-third in microbial biomass. Fecal N degradation in the pat is usually slow, being limited by anaerobic conditions at first, then by dry conditions. There is a need to discover what management will optimize the relationship between plant growth and N cycling in the full range of climatic conditions.

Key Words: nitrogen, cattle, supplementation

301 Effects of grazing management on productivity of cow/calf and stocker cattle with an emphasis on utilization of stockpiled tall fescue. M. H. Poore* and M. E. Drewnoski, *North Carolina State University, Raleigh*.

Improved grazing management has potential to boost productivity of beef production systems. Despite active extension programs promoting improved grazing management, a low level of grazing management remains predominant on the majority of beef cattle operations. Increased adoption will depend on understanding more than the biological responses to changed management. More attention needs to be put on sociological barriers to adoption of new management techniques. Stockpiling late summer and autumn growth and then using the resulting forage for winter grazing with carefully controlled animal access can extend the grazing season and reduce winter feeding cost. Teaching producers to stockpile and intensively graze forage during winter appears to be a good entry point for those interested in improving their grazing management because of the direct economic impact and relative ease of management. Stockpiled summer growth along with a protein supplement has long been used to winter dry beef cows on native range in the high plains. Stockpiling and tightly controlling winter grazing is only recently gaining popularity in the eastern US. Any forage can be stockpiled for later grazing, but due to a number of positive agronomic attributes, tall fescue is the main forage of interest across much of the eastern US. Date to initiate the stockpile, nitrogen fertilization rate and source, and forage quality throughout the winter season are factors that have been researched at many locations. Recent research has shown that toxicity from the endophyte is reduced during the winter period, at least partially due to a large mid-winter decrease in ergot alkaloids. There are information gaps regarding the influence of grazing management style, responses to various supplementation strategies, and how stockpiled tall fescue fits into an optimal whole-farm forage system. More research on frequency and level of forage allowance, and supplementation strategies to meet various production goals would enhance our understanding of optimal management systems for use of stockpiled tall fescue.

Key Words: grazing management, stockpiled tall fescue, winter grazing

302 Economic analysis of cost, rewards and trade-offs of alternative forage management strategies. G. A. Benson*, *North Carolina State University, Raleigh*.

Farm financial performance and cost of production data show a wide variation in revenue, expense and net returns per for individual cattle operations within regions as well as among average performance among regions. In addition, the producers' goals likely vary among farms. Therefore, few general recommendations can be made about production practices. One general recommendation is that producers keep adequate records to measure animal performance, cost of production, revenue, and net income. Estimates of the amount of forage produced that is lost and wasted during harvesting, storage and feeding total as much as 50%. Changes in management practices can reduce losses. The adoption of rotational or strip grazing can increase utilization by half, allowing increases in animal performance or stocking rate. Added costs include increases in labor and equipment use. New investments in grazing infrastructure may be needed. The cost of stored forages includes harvesting, storage, feeding out, and losses. The effective cost can be double that of comparable grazed forages. Extending the grazing season through modifications to fertilizer applications and stockpiling can be profitable alternatives to stored forages in some circumstances. Risk is inherent to rainfed forage production systems and includes reduced forage production and livestock performance and input price risk. Risk management options include carrying reserves of stored forages, purchasing forages, and purchasing forage extenders, all of which incur cost. Budgeting tools, including partial and enterprise budgets and sensitivity analysis can be used to evaluate alternative forage production practices and risk management scenarios. Case study examples based on Mid-Atlantic conditions demonstrate a substantial profit potential for low cost storage systems for hay and for intensively managed stockpiled forages for producers with the requisite management skill, interest and time.

Key Words: forage economics, beef cattle

Growth and Development: Physiology of Growth In Vivo and In Vitro

303 Modeling lifetime growth and feed efficiency in pigs. A. B. Strathe*[1], A. Danfaer[1], and E. Kebreab[2], [1]*University of Copenhagen, Copenhagen, Denmark*, [2]*University of Manitoba, Winnipeg, Manitoba, Canada*.

Animal genetic selection programs have improved growth rates, feed efficiency and produced leaner pigs at time of slaughter. These programs were based on analysis of data collected from 20 to 120 kg pigs with little or no information given on growth patterns beyond this point. Thus, a growth study was setup to obtain information on growth and feed efficiency patterns in Danish meat type pigs from birth to maturity. A total of 40 pigs (Landrace-Yorkshire × Duroc crossings) originating from 17 litters and of 3 genders were fed 7 diets in the period of 0 to 1007 days of age. Weekly BW and feed consumption data was collected. The BW vs. age data was subjected to analysis using 4 different growth functions i.e. Gompertz, Logistic, Bridges and Lopez. The BW vs. cumulative feed intake (CFI) was modeled using the monomolecular function. All mathematical functions were implemented in multilevel nonlinear mixed effect framework where nested random effects were included i.e. pig within litter. The statistical models where further updated to include a first order continuous autoregressive process and variance weights for modeling the error structure. The Lopez function was best suited to modeling the BW vs. age relations and estimated the maximum rate of growth to occur at 151.2 (SE=4.38), 163.6 (SE=3.67) and 133.0 (SE=3.49) days of age which corresponds to 117.0 (SE=4.47), 134.6 (SE=4.06) and 96.1 (SE=3.35) BW for barrows, boars and gilts, respectively. The feed efficiency curve was obtained as the derivative of monomolecular function with respect to CFI. The results showed that gilts had a distinct feed efficiency pattern when compared to the boars and barrows ($P < 0.001$). These data suggests that growth capacity in boars and barrows is not maximized in the standard growth period which may influence decisions on the time of slaughter.

Key Words: nonlinear mixed model, growth curves, pigs

304 Stimulation of skeletal muscle protein synthesis in neonatal pigs by long-term infusion of leucine is amino acid dependent. F. A. Wilson, A. Suryawan, M. C. Gazzaneo, R. A. Orellana, H. V. Nguyen, and T. A. Davis*, *USDA/ARS Children's Nutrition Research Center, Critical Care Med. Div., Dept. Pediatrics, Baylor College of Medicine, Houston, TX*.

Infusing leucine for 1 h increases skeletal muscle protein synthesis in neonatal pigs, but this is not sustained for 2 h unless the leucine-induced fall in amino acids is prevented. We aimed to determine whether continuous leucine infusion can stimulate protein synthesis for a prolonged period when baseline amino acids are maintained and to identify signalling mechanisms involved. Overnight fasted 7-d-old pigs were infused for 24 h with saline, leucine (400 $\mu mol \cdot kg^{-1} \cdot h^{-1}$), or leucine with replacement amino acids (n=6/group). Fractional protein synthesis and translation control mechanisms were examined in skeletal muscle. Amino acid replacement prevented the leucine-induced fall in plasma amino acids. Leucine stimulated muscle protein synthesis ($P<0.05$), but only when replacement amino acids were infused to maintain fasting levels. Leucine had no effect on phosphorylation of protein kinase B, AMP-activated protein kinase, tuberous sclerosis complex 2, signalling proteins upstream of mammalian target of rapamycin (mTOR). Leucine also did not alter phosphorylation of raptor or PRAS40 nor the association of mTOR with raptor, GβL, or rictor, regulators of mTOR. Phosphorylation of mTOR, as well as its downstream targets that regulate translation initiation, eukaryotic initiation factor (eIF) 4E binding protein (4EBP1) and ribosomal protein S6 kinase, as well as eIF4E•eIF4G association were increased, and eIF2α phosphorylation was reduced by leucine, in the absence and presence of replacement amino acids ($P<0.05$). Thus, prolonged infusion of leucine activates mTOR and its downstream targets that regulate translation in skeletal muscle, irrespective of the circulating levels of the other amino acids. However, the ability of leucine to stimulate muscle protein synthesis is dependent upon amino acid availability. *Supported by Ajinomoto Amino Acid Research Program and USDA/ ARS 6250510000-43.*

Key Words: muscle, amino acids, protein synthesis

305 Dietary starch effects on metabolic gene networks in *longissimus lumborum* of early–weaned angus steers. D. E. Graugnard*, L. L. Berger, D. B. Faulkner, and J. J. Loor, *University of Illinois, Urbana*.

Post–weaning evaluation of gene expression networks driving adipogenesis and energy metabolism provides a means to examine long–term effects of nutrition on *longissimus* muscle development. Angus steer calves (155 ± 10 d age, n = 7/diet) were fed high–starch (HiS) or low–starch (LoS) diets for 112 d followed by a common finishing diet