DIVISION OF AGRICULTURE
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# Beef Cattle Research Update

United States Department of Agriculture, University of Arkansas, and County Governments Cooperating

## What's Inside



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## GMO Crops in Animal Nutrition

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Agriculture is associated with several critical societal issues, including carbon footprint and climate change, water use, biodiversity, food security, early childhood nutrition and food vs. feed vs. fuel. As an industry, agriculture needs to do a better job communicating with a public that in industrialized countries has become too distant from current agricultural practices.

Improvements in animal productivity (growth rates, milk production, etc.) are critical to increasing the efficiency of animal production and reducing the footprint of animal agriculture. These improvements have largely come from dilution of maintenance, while other improvements can come from increased digestibility or nutrient availability from feeds, reduced nonproductive days for dairy or genetic selection for feed efficiency.

Since feed is a large portion of the inputs in animal agriculture, its impact on the overall footprint of animal agriculture, as well as on the labor and profitability of farms, needs to be well understood. Since the adoption of genetically modified (GM) crops more than 20 years ago, they have been widely adopted in the U.S. and other regions, resulting in a reduced carbon footprint of crop production.

### Benefits and Controversies

Genetically modified crops in the 20+ years since their commercialization have predominantly benefited farmers and the environment. Although transgenes have not been introduced to directly improve yields, there have been yield gains that were realized due to effective control of weeds, insects and, most recently, drought stress.

Society at large benefits from yield gains attributable to GM crops because harvesting more crops per hectare creates the potential to use less cropland and increase habitat for biodiversity and wildlife without impacting food security. In 2014, without the crop gains due to GM, 20.7 million hectares of additional land would have been needed, which is equivalent to all of the farmland in Iowa and Missouri.

Likewise, for 2014, there have been reductions in greenhouse gas emissions (equivalent to 10 million cars for one year) and pesticide use. A meta-analysis also concluded that GM crops have reduced chemical pesticide use by 37 percent, increased crop yields by 22 percent and increased farmer profits by 68 percent. Their data also demonstrated that yield and profit gains were actually greater for developing countries than developed countries.

Recently, the National Academies of Science conducted a comprehensive review of GM crops and concluded that there was no evidence of a risk to human health from GM crops compared with conventional crops. In spite of this relevant conclusion, for many critics and consumers, scientific findings are unconvincing in light of alternative preferences and biases. Part of the blame might be due to companies that did not see the coming impact of social media and the internet and therefore failed to communicate with consumers.

Genetically modified crops have been widely adopted by growers because they benefit from the introduced traits that help protect plants from insect damage, allow no-till methods of weed control and other means to maximize yield on minimal acreage. In spite of the fact that every major global regulatory group has approved the safety of the crops they have reviewed, there continues to be some concerns. Consumers often deal with confusing information that does not explain the benefits of biotechnology; therefore, GM seed providers and agricultural scientists need to be able to provide accurate information to make science-based decisions and to understand their benefits to reducing the impact of agriculture on use of land and other resources.

# Impacts of Maternal Nutrition on Uterine and Placental Vascularity and mRNA Expression of Angiogenic Factors During the Establishment of Pregnancy in Beef Heifers

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Placental development occurs early in gestation and supports fetal growth by enabling nutrient, gas and waste transfer between fetal and maternal circulations. Therefore, optimal embryonic development depends on the formation of a healthy placenta. Embryonic loss during early pregnancy is associated with impaired placental vascularization and development. Placental growth and development are closely related to fetal growth, and both are sensitive to maternal nutrient supply from the earliest stages of pregnancy. Inadequate maternal nutrient supply leads to poor placental development, resulting in compromised fetal growth. Impaired pregnancies have also been shown to have long-term effects on the offspring by decreasing health and productivity of the offspring throughout their lives.

Placental circulation provides the developing conceptus with a uterine environment that is able to meet its metabolic demands throughout pregnancy. Extensive changes in vascular volume, surface area and density and vascular ratio (vascular volume/tissue volume) occur during mid gestation in the uterus and late gestation in fetal tissues of sheep. However, angiogenesis begins during early gestation to support fetal growth, and the identification of potential regulators was completed in an attempt to understand angiogenesis during pregnancy. These include the vascular endothelial growth factor (VEGF) family and endothelial nitric oxide synthase (eNOS). Thus, we hypothesized that maternal nutrient restriction initiated at the time of breeding would influence vascular development and mRNA expression of angiogenic factors during the first 50 days of gestation in first parity beef heifers.

- Commercial Angus crossbred heifers (n = 49; ~ 16 months of age; BW = 324.5 ± 28.8 kilograms) were transported 229 kilometers from Central Grasslands Research Extension Center (Streeter, North Dakota) to the Animal Nutrition and Physiology Center (North Dakota State University, Fargo). The heifers were housed in pens with six heifers per pen and individually fed daily in an electronic head gate facility at 0800 hours. Heifers were maintained on a total mixed ration (48.4 percent DM, 5.3 percent CP, 29.4 percent NDF, 6.8 percent ash), supplemented with dried distillers grains with solubles (87.5 percent DM, 31.3 percent CP, 53.4 percent NDF, 8.2 percent ash), and granted ad libitum access to water.
- One half of the heifers were assigned to control treatment (CON) targeted to gain 0.45 kilograms per day and the remaining heifers were assigned to restricted treatment (RES), which received 60 percent of CON. Thus, experimental design for the pregnancy analysis was a 2 × 3 factorial design. Nonbred, nonpregnant control heifers (NB-NP; n = 6) were ovariohysterectomized on day 16 of the luteal cycle following the synchronization cycle. The NB-NP heifers and heifers ovariohysterectomized on day 16, 34 and 50 fed CON diet were used to address comparisons of pregnancy status and stage of gestation.
- In conclusion, nutrient restriction decreased VEGF expression and overall vascular volume while the vascular ratio was also influenced by nutritional plane but dependent on stage of gestation. Therefore, we conclude that limited effects on vascularity occurs before day 50 of gestation within the pregnant horn due to nutrient restriction, but decreased vascular development in the uterine horn contralateral to the embryo in beef heifers was observed in response to a 40 percent nutrient restriction during the first 50 days of gestation in beef heifers.

# Best Management Practices for Newly Weaned Calves for Improved Health and Well-Being

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Morbidity and mortality in newly weaned calves resulting from bovine respiratory disease (BRD) continue to be the most significant problems facing the beef industry. Morbidity attributed to BRD accounts for approximately 75 percent of total feedlot morbidity. Several experiments have documented the economic impacts of BRD. Direct costs attributable to BRD include death loss, treatment and labor costs and prevention costs, while indirect costs associated with BRD include decreased growth performance and feed efficiency, increased days on feed and decreased carcass merit and market value. In recent years, cattle treated for BRD have returned $50 to $250 less per head at harvest than cattle never treated for BRD.

Best management practices for newly weaned calves vary depending on a multitude of factors including season of year calves are purchased, calf genetics, length of time in the marketing and transport channels, previous management and vaccination programs and other factors. In general, calves purchased directly from a ranch have fewer health problems than calves purchased through auction markets. The longer a calf is in the marketing chain, the more likely health problems will be encountered. Calves that have spent several days in the marketing chain may develop clinical BRD before or very soon after arrival, whereas cattle with less time in the marketing chain may get sick later (two to four weeks), due to the length of time it takes for BRD to develop. On or before arrival, calves should be given a risk score (high, medium or low) that relates to the quantity and magnitude of stress they have encountered and the probability they will develop BRD. High-risk calves typically will have been recently weaned, received no vaccinations, not been castrated or dehorned, been commingled and moved through an auction market. Low-risk calves will often originate from a single source and will have gone through a preconditioning program that includes vaccination, castration, dehorning, weaning and potentially feed bunk adaptation.

Variation exists within risk category, so the preliminary assessment should be combined with visual observation on arrival as additional health assessments and feed intake information becomes available. Cattle managers should adjust management strategies based on risk category to meet the perceived needs of individual lots of cattle to improve the health and well-being of newly weaned calves.

# Management Strategies for Intensive, Sustainable Cow-Calf Production Systems in the Southeastern United States: Bermudagrass Pastures Overseeded With Cool-Season Annual Grasses and Legumes

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Most companies and management systems have been concerned about the sustainability of their operations, products, customers and employees. Agriculture has similar concerns of sustainability with various livestock components and products.

The U.S. Roundtable for Sustainable Beef (USRSB) is a multi-stakeholder initiative that was developed to support sustainability of the United States beef value chain (USRSB, 2016). The USRSB (2016) works in collaboration with the Global Roundtable for Sustainable Beef (GRSB, 2016) to meet beef value goals.

The GRSB (2016) has defined "sustainable beef" as a socially responsible, environmentally sound and economically viable product that prioritizes natural resources, efficiency and innovation, people and the community, animal health and welfare and food. The natural resources principles of the GRSB (2016) are also components of sustainable pasture systems in the southeastern United States in that the following criteria are included: (1) practice environmental stewardship with adaptive management; (2) implement practices to improve air quality; (3) minimize net greenhouse gas emissions; (4) protect grasslands, native ecosystems and high conservation value areas from land conversion and degradation; (5) implement land management practices that conserve and enhance ecosystem health; (6) incorporate efficient management of water resources to support ecological function and availability; (7) use appropriate management practices to maintain or

improve soil health; (8) enhance native plants and animal biological diversity; and (9) implement management practices for sustainable-product feed sources.

The primary themes of GRSB (2016) and sustainable beef value are dependent on management strategies and practices as the criteria for success. In the southeastern United States, bermudagrass pastures overseeded with cool-season annual forages, management strategies based on foundational databases and the objectives to enhance livestock product without degradation of the soil-pasture-water resources are components of sustainable cow-calf production.

Intensive cow-calf production in any vegetational zone or climatic area is subject to definition and clarity of the intent of "intensive." In general, "intensive" may have an array of intended and unintended uses and perceptions of definition. In the southeastern United States with bermudagrass and other warm-season perennial grass pastures, intensive cow-calf is uniquely linked to management strategies such as fertilization, overseeding, stocking rate and economic viability.

Sustainable cow-calf production in the southeastern United States is closely and inseparably associated with beef industry challenges and opportunities; land-use, economic rewards and incentives for stakeholders; and management strategies that affect soil nutrient status and stand maintenance of warm-season perennial grass pastures and overseeded cool-season grasses and legumes. Hybrid, common, and ecotype derivatives of bermudagrass provide the centuries-long, core stability for sustainable pastures under grazing conditions in the southeast. Soil nutrient management with fertilization or legumes for N fixation, intensity of defoliation regimens and stocking rate on bermudagrass are the primary management strategies that control the desired level of cow-calf production. Stakeholder management strategies control the degree of intensity of cow-calf production based on level of economic risk and desired environmental stewardship options. These strategies should be based on integrating relationships of pasture ecosystems and stand maintenance, environmental awareness, economic implications and legacy-heritability objectives of property for strategic, sustainable forage-livestock production in the southeastern United States.

*Articles were edited for length and style.*

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