Alfalfa is not a new crop in the southeastern U.S., but economic conditions have increased the demand for high-quality forage and has spurred an expansion of alfalfa production in the southeastern region. Recent price increases in fertilizer, supplemental feeds, minerals, and transportation costs have placed a premium on high quality, locally-produced forage. Conventional alfalfa varieties now have greater yield potential, stress tolerance, winter hardiness and persistence than at any time in the past. This work proposes to extend the production and utilization of alfalfa in the southeastern U.S. by using two approaches. First, we seek to improve forage yield and persistence of alfalfa stands through better nutrient management (K fertilization) and harvest strategies that can lessen the effects of abiotic stress under southeastern climatic conditions. Second, we seek to evaluate the impact of alfalfa in an alfalfa/bermudagrass mixed grazing system to improve forage quality of perennial warm-season grasses, extend the grazing season, enhance animal performance, reduce the environmental impact of N fertilizer applications, and optimize economic returns. Both of these approaches will have an immediate impact on the AFRP’s Purpose and Priorities to expand alfalfa acreage and production into non-traditional alfalfa regions. In this proposal, we indicated how these two aspects of alfalfa production are connected. By integrating fertility, harvest management and grazing management, producers can assess the potential to extend the persistence of alfalfa and alfalfa/grass mixtures with less weather related-risk. These systems can expand the regional markets for alfalfa production and utilization in the southeastern U.S., ultimately affecting over 1.8 M hectares of beef cattle production. Extension demonstrations with pure stands and inter-seeded alfalfa into warm-season perennial grasses has peaked interest among beef cattle producers. This has created a demand for extension education efforts and scientific data to train producers, agricultural agents and government personnel on how to manage alfalfa stands to maximize hay production and livestock performance. Producer and scientists alike are continuously seeking new approaches to increase forage diversity, improve biomass production and increase nutritive
value. Extending stand longevity while minimizing yield losses under high temperature and moisture conditions is crucial to provide animals with the necessary forage allowance that increase weight gain. Unfortunately, very little information is available that targets alfalfa or alfalfa-grass mixtures produced under growing conditions of the southeastern U.S. At this stage of evaluation, selecting potassium application rates, understanding proper harvest maturity, and identifying management strategies of inter-seeded alfalfa in grazing systems appears to hinge as the most important goals for livestock producers. We propose an integrated and synergistic extension and applied research work frame. The extension component will promote the use of alfalfa and alfalfa-grass mixtures for beef cattle producers by providing tools that improve persistence and nutritive value of their grazing systems. The research component will assess the need for efficient nutrient and harvest strategies that extend the persistence of the alfalfa stand and increase economic returns. As a result, alfalfa acreage in the Deep South will increase once again creating huge ramifications from both a feeding and environmental standpoint. This expansion has been supported by several new and on-going research projects, and extension efforts by scientists at various Land Grant universities. These efforts have resulted in the sustainability of high alfalfa yields, forage quality, and persistence in the southeastern U.S. Grazing alfalfa can become a significant option for livestock producers in the region, especially the "grass-fed" meat market and dairy production. Alfalfa has the potential of being the most profitable forage system in the southeastern U.S. when the economics of producing alfalfa become increasingly attractive as alfalfa management strategies for high yields and long stand life are confirmed.

**Animal Health Component**

**Research Effort Categories**

- Basic: 40%
- Applied: 60%
- Developmental: (N/A)

**Classification**

- Knowledge Area: 307 - Animal Management Systems; 205 - Plant Management Systems;
- Subject Of Investigation: 1610 - Pasture; 1699 - Pasture and forage crops, general/other;
- Field Of Science: 1060 - Biology (whole systems);

**Keywords**

- alfalfa
- bermudagrass
- grazing management
- harvest frequency
- potassium
**Goals / Objectives**
To determine the impact of K fertilization and harvest regime on forage yield, plant persistence, forage quality, and yield component of alfalfa in the southeastern U.S. To compare concurring production of “Georgia Bulldog 805” alfalfa in a legume/warm-season grass mixture system with bermudagrass vs. nitrogen application to determine species competitiveness, forage mass, nutritive value, animal performance, and the economic net return of alfalfa/grass system in a hot, humid southeastern U.S. To implement an Extension and Outreach program to educate beef cattle producers and small and medium-sized dairies about the use of alfalfa nutrient management, harvest regime, and alfalfa-grass mixtures grazing strategies by providing the linkages.

**Project Methods**
**Objective 1:** Impact of potassium application and harvest regime in alfalfa yield, forage quality and stand persistence. The experiments will be conducted across three states in the southeastern region (Tifton, Georgia; Franklinton, Louisiana; and Newton, Mississippi) during three growing seasons (2017 to 2019). The experiment, a randomized complete block design with four replications, will be set up in the fall of 2016. Plots will be 1.8 m x 4.6 m. "Georgia Bulldog 805’ alfalfa will be planted at a rate of 22 kg pure live seed (PLS) per ha in a prepared seed bed. A split-plot arrangement of the experimental treatments will be used. The main plots will be the harvest regimes and the subplots will be the potassium (K2O) application rates. Alfalfa will be harvested at four maturity stages [bud and three bloom stages (1/10, 3/10 and 5/10). Muriate of potash (0-0-60) will be applied at a rate of 0, 67, 101, 134, and 168 kg K/ha split applications (before first cut, after second cut, and fall before last cut). We expect to have four harvests per year before the critical fall rest period. Percent bloom stage will be determined by taking two random Provenience square readings in each plot. Plots will be fertilized at planting, according to soil test recommendations for lime, phosphorous, boron and zinc. Soil samples will be collected from each plot from the 0- to 15-cm (soil) and 15- to 30-cm (subsoil) soil depths at the beginning (prior to fertilization) and at the end of the growing season to determine exchangeable K levels. Soil samples will also be collected in each plot prior to seeding. Chemical control of pests (weeds and insects) will be applied when it is necessary. Stand density will be rated after the first and last harvests every year by counting the number of plants within three 0.1 m2 quadrats placed at a random location within the plot. Visual estimate of the percent ground cover will be taken. A subsample of 100 shoots will be randomly hand-collected within each plot before harvest. Fifty shoots will be used for botanical separation and estimation of leaf:stem ratio. Fifty shoots will be used to determine mass/shoot. All samples will be dried at 55°C and weighed. Shoots/m2 will be calculated by dividing yield/m2 by mass/shoot. Alfalfa yield will be determined by harvesting the whole plot. A 500-g wet sample of herbage will be collected from each plot for moisture determination and subsequent mineral (K, Ca, P, Mg, and S) and forage quality analysis (CP, ADF, NDF, and lignin). Estimate of nutrient removed by the forage will be calculated by multiplying the yield at each harvest by the concentration of nutrient in the forage.

**Objective 2:** Alfalfa Utilization in Southern Pasture Systems to Improve Beef Production. The grazing study will be conducted at three locations across three states (Georgia, Louisiana, and Mississippi) in the southeastern region for three growing seasons (2017 to 2019). The grazing study is a randomized complete block design with two replications, three pasture composition treatments, including bermudagrass with no nitrogen (BGZ), bermudagrass with 90 kg N/ha applied in an evenly split manner (BGN) and bermudagrass interseeded with alfalfa (BGA). Each
A grazing paddock will be 0.80-ha in size. Bermudagrass will be suppressed before alfalfa planting by spraying with paraquat (Gramoxone) at a rate of 1 qt/ac. "Georgia Bulldog 805" alfalfa will be planted at a rate of 28 kg PLS per ha using a no-till drill. Soil samples will be collected from each plot for the depth of 0- to 15-cm (soil) and 15- to 30-cm (subsoil) at the beginning (prior to fertilization) and at the end of the growing season. Pastures will be fertilized based on soil test recommendations. Herbage availability (kg/ha) at the beginning and end of each grazing period will be determined by taking 30 readings with a calibrated rising plate meter (RPM) and clipping herbage within six randomly placed 0.25 m² quadrats in each paddock to a 2.5-cm height. Three of the quadrats will be manually separated into botanical components to determine the proportion of bermudagrass, alfalfa and other herbage (weeds and dead material). Another three-quadrat samples will be processed as described in Objective #1 to determine crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and lignin. A variable put-and-take stocking system based on forage mass will be used with four to six tester beef steers (Bos Taurus x B. indicus) permanently assigned to each pasture and extra grazer steers added (put) or removed (taken) when needed to meet target grazing criteria. All animal protocols will be submitted to each participating institution’s Animal Care and Use Committee. Each paddock will be grazed for 7-10 days and a rest period of 20-30 days depending on the treatment. Each grazing cycle will start when the paddocks have reached 25-cm of herbage height with the exception of the alfalfa paddocks that will start when alfalfa paddocks have reached the 1/10 bloom stage and end when the herbage mass in the paddock has reached 2.5-cm stubble height. Prior to adaptation, steers will be blocked into groups on the basis of live-weight and each group will be assigned to a pasture for grazing. All steers that will be used in the study will graze bermudagrass for 7 days prior to the start of the grazing season in each year. Steers grazing alfalfa pastures will have access to poloxalene blocks (PM Ag Products, Homewood, IL) to prevent bloat. When cattle are removed from each paddock, they will be placed in a bermudagrass pasture with no fertilization and hay will be fed as needed. The steers will be weighed after each grazing cycle and at monthly intervals as well as when stocking rates are adjusted. To determine the live weight gain per hectare for varying animal daily gain (ADG), gain per hectare per day will be calculated as the product of ADG of tester animals and the total number of animals per hectare (tester + grazers) at the end of the grazing cycle and then summed over the entire grazing season. Forage allowance per steer per day will be calculated as forage mass at the beginning of the grazing period divided by paddock size, number of steers in the paddock, and number of days the paddock will be occupied. Objective 3: Extension and Outreach Component. Interest in alfalfa nutrient management and inter-seeding alfalfa into grass hayfields has created demand for a greater extension education effort in the southeastern U.S. The demand focuses in two main areas: (1) train producers in how to plant, fertilizer and harvest at the right stage to maintain persistence and (2) plant and manage alfalfa in an alfalfa-grass mixture system for grazing. In the southeastern U.S., a coordinated research and outreach/demonstration effort, across Georgia, Louisiana and Mississippi has increased alfalfa acreage and awareness of the benefits of legumes in forage production systems. Since alfalfa adoption has been very low in the past in the Deep South, some of the targeted producers in the region have a negative view of alfalfa production and its management challenges. Many of these efforts have been under the pretext of demonstrating establishment, nutrient, and harvest/grazing strategies discuss the benefits of alfalfa production and use in integrated hay and grazing production systems. This results in participants understanding the potential of alfalfa as a forage crop because of the nutritive value, nitrogen fixer, and compatibility for legume/grass grazing.
system. We believe that a more robust and well-funded extension effort across the southeastern U.S. in collaboration with agricultural agents and key producers and integrated with extension.org could have a much larger impact, especially of guidance about how alfalfa nutrient management and compatibility with warm-season grasses can be fine-tuned.