Exploring New Forage Options to Address Emerging Dietary & Environmental Challenges in Dairy Forage Systems

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Dairy and forage producers are always facing new challenges. One of these challenges is to find forages that meet the specific nutritional needs of livestock at different stages of growth or production. Another challenge is to find ways for perennial forages to help preserve soil quality within a predominantly corn-silage cropping system. The list goes on and on.

In an effort to provide new and improved forage options to meet these emerging challenges, the U.S. Dairy Forage Research Center takes a multidisciplinary, whole-farm system approach to research. Here are two examples:

Eastern gamagrass, a native warm-season grass, grew well in central Wisconsin.

The Challenge: Reducing Excessive Weight Gain in Dairy Replacement Heifers Fed a Corn Silage-Based Diet.

Background: In many regions of the U.S., including the Midwest, corn silage is the most economical forage to grow for dairy heifers. Although high-energy diets containing corn silage can increase average daily gain and reduce the age at first calving, this practice also can be counterproductive. For example, increased prepubertal average daily gain is known to have a negative effect on mammary development and first-lactation milk yield.

Generally these problems arise because corn silage is energy dense and often exceeds the energy requirements for dairy heifers. As a result, heifers can become over-conditioned. A common approach to this problem has been to add straw to the corn silage-based diet, but straw often is sorted by heifers, frequently must be purchased, and the price of straw has risen due to increased competition for use in both heifer and lactating-cow diets.

Other agronomic options exist for limiting caloric intake in heifer diets. Perennial warm-season grasses have characteristics – such as high concentrations of fiber components and low concentrations of cell solubles – that are consistent with low-caloric content. Eastern gamagrass is a native warm-season grass that might fit the bill due to its high production potential, responsiveness to nitrogen fertilization, and proven suitability for silage fermentation.

Agronomic studies: Although eastern gamagrass is well-adapted in many regions of the U.S., there had been no known attempt to evaluate this forage critically within central Wisconsin. This prompted the objective to evaluate the agronomic characteristics, yield potential, and recovery of fertilizer nitrogen for eastern gamagrass forages grown in central Wisconsin. Forages were managed with six single-harvest and three multiple-harvest schedules, and fertilized with four rates of nitrogen.

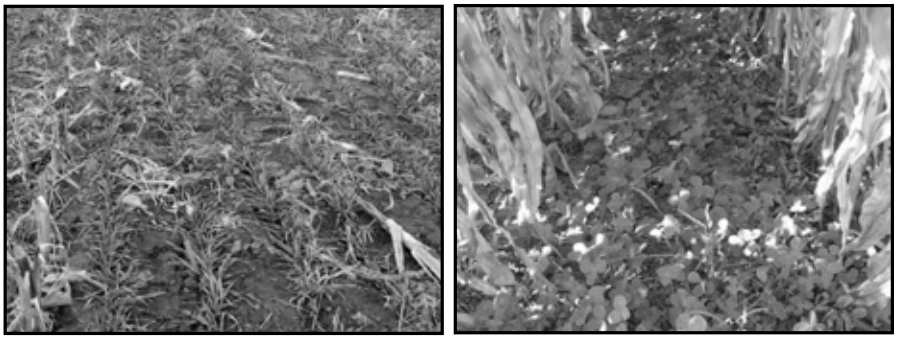
Agronomic conclusions: The concept of using perennial warm-season grasses at northern latitudes, specifically to dilute the energy content of blended diets for replacement dairy heifers, appears viable from an agronomic standpoint. Based on the results, eastern gamagrass will likely survive indefinitely in central Wisconsin. However, during the three years of this trial, there was continuous snow cover throughout the winter. It remains unclear how eastern gamagrass plants may survive in this environment without natural insulation from cold temperatures.

Based on past work, double-harvest systems will provide better forage quality characteristics than single-harvest systems. However, yields from double-harvest systems in this study were not competitive with one-time harvests during early- or mid-August. Continuing accumulations of dry matter through mid-August suggest that yields may be increased further by delaying a one-time harvest until even later into the summer.

Most current management recommendations for eastern gamagrass emphasize a very conservative philosophy with respect to growth-reserve status. Potentially, delaying a one-time harvest even closer to first frost could have a negative effect on persistence. For this dietary application, there is no incentive to maintain nutritive value; in fact, the greater the concentration of NDF the better. This approach (intentionally delaying harvest) in order to increase yields may be viable, and is being evaluated currently.

The study also indicates producers should expect clear yield benefits from a one-time application of nitrogen at rates ranging from 50-100 lbs N/ac, but diminishing returns are likely at higher application rates. This nitrogen management approach also minimizes the potential for leaching of nitrates by avoiding excessive accumulations within the soil profile.

Dairy applications: The second part of the whole-farm approach was to look at eastern gamagrass from a nutritive standpoint – to evaluate macrominerals, crude protein, and fiber composition; and then to estimate energy densities for these forages. Forage samples were taken from the nine different harvest systems at four different nitrogen fertilization rates. In addition, an initial 120-heifer feeding study was conducted to evaluate eastern gamagrass as an energy diluting agent within dairy-heifer diets.



Soil quality was measured in no-till silage corn fields grown with different companion crops, including fall-seeded rye as a cover crop (left) and red clover as a companion crop (right).

Dairy application conclusions: Unfortunately, the methods used in the initial agronomic study could not confirm or reject whether eastern gamagrass grown in a cool environment is truly low-energy forage. However, an initial 120-heifer feeding study has shown that substituting eastern gamagrass for the corn silage within alfalfa-corn silage diets was effective at limiting weight gains for 1,000-pound dairy heifers. It was necessary to include eastern gamagrass haylage at about 30% of the total dietary dry matter in order to reach typical targets for growth (1.8-1.9 lbs/day). Eastern gamagrass yields high concentrations of NDF when grown in a cool environment, and these high NDF concentrations also will act to limit energy intakes of dairy heifers on the basis of gut fill. This hypothesis also was verified in the (120-heifer) feeding study. An additional benefit of including eastern gamagrass within these diets was that heifers showed no inclination to sort eastern gamagrass particles from the blended diet, which is a common problem when straw is used for the same purpose.

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The Challenge: To Decrease the Risk of Soil Degradation in a Corn Silage System.

Background: Corn silage is an integral part of most dairy cattle rations. The removal of both grain and stover for silage increases the risk of soil degradation due to several mechanisms. The lack of above ground residue renders the soil vulnerable to runoff and erosion, even without tillage; and insufficient biomass return can degrade the soil through loss of soil organic carbon and nutrient depletion.

An important question for many dairy farmers is how to produce this important feed without exacerbating soil erosion or risking future soil productivity. A similar question is also being asked by those considering the harvest of corn stover as feedstock for bioenergy and other bioproducts.

Two management practices – application of manure and use of companion or cover crops – have been proposed as strategies that could make silage production more sustainable. These practices provide an input of carbon (i.e., organic matter) to serve as an energy source and substrate for biological activity, and they create cover to decrease the length of time that soils are bare. But how can it be determined whether manure application and/or cover crops are truly improving soil quality, thus, making corn silage production more sustainable?

Past studies by researchers have shown varying results in soil quality improvement due in part to differences in soil type, manure type (liquid or solid), manure application rate and method, cover crop variety, location, and climate.

Soil quality study: For this study, several no-till silage corn cropping systems were established that included legume or grass companion/cover crops on which liquid dairy manure was applied. The objective was to evaluate the effect of these management variables on selected soil physical, chemical, and biological properties and on overall index of soil quality after four years of treatment. (*See March 2012 issue of Forage Focus for an article describing the agronomic aspects of this 4-year companion crop study.*)

Soil quality conclusions: Use of kura clover, red clover, Italian ryegrass, or winter rye as cover or companion crops improved several chemical, physical, and microbial soil properties as well as overall soil quality in a no-till silage corn system with dairy manure. While some specific companion/cover crops performed better for individual soil properties, none stood out as better for the whole range of soil attributes or for overall soil quality as determined with the SMAF (Soil Management Assessment Framework) soil quality index.

Liquid dairy manure alone (control plot with no companion crop) did not improve soil quality indicators, perhaps because a portion of the large particle-size solids had been removed by solids separation, resulting in a low-solids manure with more easily decomposable organic carbon and only transient effects on microbial activity and other soil qualities.