USING GRAIN AND FORAGE SORGHUM IN DAIRY RATIONS IN AN ENVIRONMENT OF LIMITED WATER RESOURCES

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ABSTRACT

High quality forage is the base of every lactating dairy ration. Corn silage and alfalfa hay are the king and queen of these forage ingredients. Both of these crops require significant amounts of irrigation or rainfall to produce acceptable yields. The traditional dairy areas of the upper Midwest enjoy ample rainfall to produce large volumes of both alfalfa and corn silage. Over the last 50 years, the dairy industry has seen a western migration. Significant milk production remains in the traditional Midwestern states, but the western dairy migration has changed the dynamics of the industry. Due to the arid climate in the West, irrigation has been heavily utilized to produce dairy forages. Declining water availability has increased interest in sorghum silage to replace some or all corn silage. Questions surrounding starch availability in the grain from sorghum silage bring uncertainty into diet formulation and have limited its acceptance and use.

Key Words: sorghum silage, dairy, starch availability, irrigation, water-use

The westward dairy migration has several explanations. Chief among these is distance from urban centers, reduced land costs and drier climates. Dairy cows perform well in dry climates, especially when large numbers of cows are concentrated in modern facilities. Higher cow density plus rainfall result in numerous challenges. Additionally, lower relative humidity is a significant positive factor to enhance milk production per cow and overall animal comfort. The extreme level of metabolic activity in a producing dairy animal is a poor mix with hot and humid weather. When humidity is added to heat, voluntary feed intake is reduced significantly and reductions in milk production follow. These intake reductions can be significant and may result in a 20% loss in milk flow.

The unintended result of this quest for low humidity is an increased dependence on irrigation. Much of the feed used in dairy rations is in the form of wet forages. Silages need to be grown close to the dairy facility to minimize freight as an overall contributor to forage cost. Hauling is a significant cost issue in the dairy industry due to the high moisture content of feed coming in and milk going out. As a result, dairy farms locate themselves close to irrigation sources and dairy processing plants. When a dairy facility is built, a risk exists relative to how long irrigation sources will be viable. In most cases, these uncertainties relate to the longevity of an aquifer, the

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unpredictable politics of river water or the climate driven uncertainty of mountain snowfall. Many dairy producers find themselves in a situation now where these questions have been answered, and not in their favor. A significant portion of the dairy industry is located in areas where mid to long term water availability is uncertain at best. Reductions in both water allowed from a regulatory viewpoint and water actually available due to declining aquifers and multi-year droughts is the new normal in the West. The industry has invested in infrastructure to produce and process milk in these areas. Now the industry is tasked with developing angles to produce milk with less water. It is incumbent upon the dairy industry to consider crops that are more adapted in a declining water environment. Chief among these ideas is a move from corn silage to various sorghum species. The sorghum plant is certainly one that has production potential with less water. Plant geneticists have combined the best traits of grain sorghum and its much taller cousin, sudan grass and produced a taller and larger hybrid that has strong yield potential. These hybrids are not new to the market, but their applicability and acceptance into large scale milk production is still a work in progress.

Efforts to increase sorghum use in dairies have been met with some resistance. However, in some areas, producers are beginning to see the yield potential. But up to this point, corn silage still gets the nod if irrigation is available. The decision to choose sorghums to stretch available water has been less common. The probable reason for the slow adaption is the reality or perception of lower milk production potential with sorghum silage. This bias is equally common among dairy producers and their nutritionists. In short, sorghum has an up-hill battle.

In response to the questions of quality, investigators in the arid West have conducted yield trials to measure production potential and nutritional value. These results have been helpful in allowing producers to select for yield, fiber digestibility and grain content. In general, there are two options when selecting these hybrids. The choice is between a taller, leafy type plant and one that is moderately tall, but still makes a grain head. In many yield trials, the higher grain producing varieties posted high marks for milk per ton and milk per acre. The grain kernel that is found in the species is of high value and can contain as much as 50-70% starch. As one might suspect, it is these varieties that are commonly grown for dairy feeding.

There is a significant question dairy nutritionists must consider when including these higher grain content hybrids into dairy rations. What is the true availability of the grain kernel in sorghum forages? If the presence of that kernel is driving variety selection, we must answer some questions about its availability to the animal. This is a question of more significance in the dairy cow diet compared to beef cattle applications. The dairy cow may have a significant portion of their diet from silage compared to a feedlot animal. As well, the rate of passage in a dairy diet is rapid. This is due to the significant drive for intake for high milk production. Undigested nutrients from various ingredients are always a concern in this rapid passage rate environment. This nutrient rich kernel is at a significant risk of being undigested by the animal.

In the top of the rumen of a dairy cow there is a “raft” that is a mesh of sorts built from roughage in the diet. It is from this mass that the animal brings up cud to chew and re-chew. This is necessary to reduce the particle size of hays and silages to allow for full digestion. To some unknown degree, the small, smooth and dense milo kernels in sorghum silage make their way through this sieve and fall through the fluid to the bottom of the rumen. Agreeably, much of this is speculation; but to be sure, the amount of milo kernels that are found in dairy manure bolsters the assertion.

The disconnect between the variety trials and the application of sorghum silage nutrients into a nutrition model is centered around the physical form of this kernel. In lab analysis, the samples are ground to a small particle size and then subjected to a variety of analytical procedures. These kernels are mostly intact when actually consumed by the animal.

It is fair to mention that grain in corn silage has the same risk of indigestibility. The difference is that in corn silage harvesting equipment is a set of processing rolls that reduce the particle size of the corn kernel. It is now the industry standard that kernel processing is employed in nearly all corn silage harvesting. The small size of the sorghum kernel makes this same type of processing difficult, if not impossible, to achieve. There have been harvest time solutions that have been proposed to solve this problem but nothing is field ready as of yet. Adjustments have been proposed and attempted with current equipment to allow for better processing of these kernels. Any progress that may have been made in this area has probably been accompanied by a significant length reduction in the sorghum forage. This is counterproductive. The goal is to adequately process the kernel while still leaving the forage portion between ¾” and 1” long. This is arguably impossible with the current industry standard harvesting equipment.

When dairy nutritionists are tasked with utilizing sorghum silage in lactating diets, the visual sorghum kernels in the manure brings an uncertainty into the formulation process. Nutrition professionals today use dynamic biological models to formulate rations. These models consider not only the nutrient value of the ingredients used, but also the interaction between ingredients in an individual diet. In short, diet formulation has surpassed a linear equation based on weighted averages of ingredients. In this fine-tuned environment, nutrient uncertainties present a real problem. These complex models not only require knowledge of the starch content of the feed material, but also the extent and rate of its digestibility in the cow. These last two pieces of information are sketchy at best as it relates to grain kernels in sorghum silage.

The authors propose research in this area to at least determine the total tract digestibility of starch from sorghum silages. By using commercial dairies feeding a high proportion of the diet as sorghum silage, sampling and analytical procedures can be employed to measure crude starch digestibility in the total tract. Though details regarding rumen kinetics of sorghum starch would be more useful in the nutrition formulation models, results of a basic total tract study would be an improvement from the visual estimation currently in use by dairy formulatorsStage of harvest can have potential positive impacts on sorghum silage starch availability estimates. Harvesting

the crop at lower maturities should allow for a higher moisture content kernel with an improved chance of rupture during harvest, processing or even chewing. However, dairy producers and farmers have been hesitant to employ this method due to yield reductions and reduced starch content. Additionally, the less mature harvest date results in higher whole plant moisture and would require swathing before chopping. This extra pass through the field adds cost to the final product, requires additional machinery and adds to soil compaction. It should also be noted that swathing less mature sorghum silage will result in higher plant protein levels thus improving its value in the ration. That being said, in most cases, direct cut sorghum silage is still preferred. The downside however, is a more mature and thus less digestible plant.

Due to the uncertainty of the sorghum grain value in dairy rations, many professionals have recommended the use of non-grain bearing options. This approach can be used by choosing either male sterile hybrids or photo-period sensitive options. The goal here is to avoid the grain all together and simply grow and harvest the wet forage. The desirability of this option has much to do with the competitive value of forage alternatives including alfalfa hay. Alfalfa hay markets have remained strong in recent months even after improved drought conditions. The loss of alfalfa acres in certain areas promises to bring continued strength to alfalfa pricing. Since the forage sorghum requires more supplemental protein than alfalfa hay, soybean meal price is also a factor. The other ingredient market that must be considered in these all-forage variety decisions is the price of corn. In the environment of sub $5 corn, the potential to simply buy needed starch and grow only forage is more feasible.

The other nutrient quality key in determining the value of sorghum silage is the digestibility of the fiber. This is an area where sorghums can even the scales when being compared to other forage sources. The use of BMR sorghums has been moderately more accepted in the western dairy industry when compared to BMR corn silage varieties. There are still real or perceived concerns by producers over lodging risk and overall yield potential. It is thought that the use of BMR genetics in sorghums may be the best way to give sorghum the needed advantage to compete with corn when the option still exists.

CONCLUSIONS

Sorghum silage, just like any other ingredient, has plusses and minuses when considered for dairy diets. The major factor indicating an increase in use in dairy rations is the ability of the sorghum and sudangrass species to produce a crop with less total water invested. This reality is likely to result in a necessary increase in its use across the western dairy industry. It is hopeful that upcoming research endeavors will answer at least some of the questions related to the value of sorghum grain in sorghum silages. Based on these results and the price value of competitive ingredients, dairy producers and their neighboring farmers can decide if higher grain content sorghums or more leafy, non-grain producing varieties are the best option.