Pasture is the primary source of forage for grazing dairies, and for organic dairies, the National Organic Program livestock production regulations require a minimum of 120 days grazing per animal. In the northern United States, this requirement is typically met by a May to October grazing season, and profitability depends on pastures that provide a uniform, season-long supply of high quality forage. However, in the northern United States, seasonal variation in temperature and precipitation creates a challenge, as the predominant forage plants, which include perennial grasses such as Kentucky bluegrass and smooth bromegrass, and legumes such as white clover, undergo a “summer slump” in production. Most pastures in the upper Midwest consist of perennial cool season species. These grasses and legumes grow well in Midwestern soils and climate and are considered high quality forage options that provide adequate nutrition for grazing dairy cows. The decreased feed availability in pastures because of slower growth of these forages may lead to decreased milk production. In addition, farmers may have to feed stored forages, which can increase their feed costs. Incorporating warm season annual grasses into pasture systems has been suggested as a solution, as these grasses will experience their fastest growth rates at the time that cool season perennials may have delayed growth. Some farmers may be hesitant to implement this solution as it is generally believed that warm season annuals have lower forage quality than cool season perennials. To create a more uniform and extended forage supply, research studies have recommended diversifying pasture systems to include warm season species in the summer.

An approach to increasing diversity in a farm’s forage base is to combine annual and perennial crops in separate fields. An example for the northern United States, would be to use cool season grasses and legumes for forage in spring and early fall, and warm season annuals like teff and sudangrass for forage in summer. Grazing systems using these different approaches to achieve diversity require biological, environmental and economic analysis.

It is important for organic dairy farmers to establish good pasture management to be able to follow the pasture rule for organic cattle. Organic cattle must graze pasture for at least 120 days of the year and 30% of their dry matter intake must come from pasture forage. Milk production is directly related to dry matter intake, which is directly related to amount of available dry matter in pasture. For cattle grazing pasture to be productive, there must also be productive pastures that provide adequate forage quality and biomass to feed cattle.

**Plan your forage supply for summer grazing.**

There are a lot of disagreements regarding the ideal number of species to include in pasture mixtures. Most agronomic guidelines recommend the use of a small number of species in grazed mixtures. Past research in the Northeast United States found that six to nine grass species were more productive than a white clover-orchardgrass mixture.

When selecting pasture grass species, producers should consider yield potential, palatability, survival of grasses. Producer should select species that are winter hardy, have good seasonal yield distribution, and are rust resistant. Quite possibly, variety is as important as or more important than specie choice.

At the University of Minnesota West Central Research and Outreach Center, in Morris, we are measuring the performance of dairy cows grazing two unique pasture systems designed to maximize seasonal forage yield and quality and extend the grazing season. System 1 will increase within-field species diversity targeting perennial cool season, polyculture pastures to enhance multi-seasonal productivity (spring, summer and fall). System 2 will increase across-landscape diversity achieved by adding a combination of perennial polycultures and annual warm season grasses fertilized with livestock manures. Regional differences in soil fertility and rainfall may favor different pasture species in other locations.
Our current perennial pasture species mixtures and seeding rates are as follows:

1. Perennial ryegrass (4 lb), White clover (2 lb), Red clover (3 lb), and Chicory (2 lb);
2. Orchardgrass (3 lb), Meadow Fescue (6 lb), Chicory (1 lb), Alfalfa (10 lb); and
3. Perennial ryegrass (3 lb), Meadow Fescue (8 lb), White clover (4 lb), Red clover (2 lb), and Chicory (1 lb)

**Warm-Season Summer Annual Grasses**

Why should summer annuals be considered by livestock producers? They are very drought tolerant and can fill a gap in feed when other species experience the “summer slump”. They are great emergency forages during dry weather and are multipurpose, so you can be use them for grazing, silage, or for baling.

**Sorghum-Sudangrass and Teff Grass**

During the summer for three grazing systems (2013 to 2015), we planted two summer annuals for grazing at the University of Minnesota WCROC dairy in Morris. BMR Sorghum-Sudangrass and Teff grass were planted to extend our forage supply. These grasses were seeded with a drill the third week of May each year.

BMR Sorghum-Sudangrass has increased in popularity due to the BMR gene and increased NDF digestibility (5-10% higher than regular sorghum-sudangrass). The plants have thick stems and are very leafy. Sorghum-sudangrass has moderate regrowth potential, but you should not graze or cut for forage until the plants are at least 18 inches tall to reduce prussic acid concentration. The ideal height for forage is 18 to 36 inches tall. When grazing sorghum-sudangrass animals should be moved so they leave 6 to 8 inches of stubble, but they might waste 20-30% of the forage through grazing. Lastly, sorghums and sudangrass are consumers of potassium, so they should not be used for dry cow forages. For seeding rate, we seeded our fields and pastures at 20 lbs/acre.

BMR sorghum sudangrass has been fed as silage to dairy cattle. Nutrition studies have been conducted in dairy cattle comparing sorghum sudangrass silage to corn silage, showing similar production. It is typically not grazed in a pasture system, so very little is known about sorghum sudangrass as pasture forage, and how it may affect grazing dairy cattle.

Teff grass is native to Northern Africa. Teff is drought tolerant and can be seeded into many different soil types. With this grass, you will have high yield with competitive forage quality, and will have rapid growth for 9 to 12 weeks. The seed is very, very small, and we seeded our pastures at 8 lbs/acre. Both of these annuals should be planted at 60 to 65-degree soil temperature and planted 1 to 1.5 inches deep. Perhaps, manure should be added as a fertilizer before planting because they have nitrogen requirements that are similar to corn.

Teff grass originated in Ethiopia and is extremely drought and heat tolerant. It has occasionally been used by some rangeland cattle producers as emergency forage but is usually fed as hay. Very little is known about the forage quality of teff grass, especially in a grazing system.

**University of Minnesota Grazing Study**

The University of Minnesota chose to study BMR sorghum sudangrass and teff grass, as organic dairy farmers in Minnesota are beginning to incorporate these grasses in their grazing programs and are interested in learning more about them. We wanted to determine how the forage quality of annual warm season grasses compare to perennial cool season pasture mixtures, as well as how they influence milk production and health parameters in grazing organic dairy cows.

For our study, ninety organic dairy cows were used in a study to compare two different pasture systems at the West Central Research and Outreach Center in Morris, MN. The first system (cool system) included a diverse mix of cool season perennial grasses and legumes such as perennial ryegrass, white clover, red clover, chicory, meadow bromegrass, orchardgrass, meadow fescue, and alfalfa. The second pasture system (warm system) was a combination of the cool season perennial mixtures and warm season annuals BMR sorghum sudangrass and teff grass. Perennial pastures were established in 2012. Warm season annuals BMR sorghum sudangrass and teff grass were planted in individual paddocks during the third week of May of each year. Forage samples were collected daily throughout the grazing seasons of 2013-2015. Dry matter was analyzed immediately after sample collection. Forage samples were tested at Rock River Labs in Watertown, WI for the forage quality characteristics neutral detergent fiber (NDF), total tract NDF digestibility (TTNDFD), crude protein (CP), and mineral content.

Holstein and crossbred dairy cows were blocked by breed, parity, days in milk, and randomly assigned to one of two systems. Cows were moved to a new paddock every two days, were supplemented 5 lb. of corn per day, and provided with free-choice mineral.
in pasture. Milk production data was collected daily. Fat, protein, MUN, and SCC were from monthly DHI testing. Body weight was recorded on cows using a digital scale as cows exited the milking parlor approximately once every 2 weeks during lactations, and BCS was measured at the same time as BW on a 1 to 5 scale in increments of 0.25, with 1 = excessively thin, and 5 = excessively fat. Cows were also fitted with SCR Heattime HR-LD Tags to monitor daily rumination and activity across the grazing season.

Across the grazing season, spring pasture dry matter fluctuated across the grazing season and was higher during August and October compared to the early part of the grazing season (June and July; Figure 1). Seasonal average crude protein concentrations were greater for the perennial pastures in the fall; however, the warm season grasses were greater for crude protein during July at the time of first grazing (Figure 2).

**Figure 1.** Dry matter of pasture grass species across the grazing season

![Dry Matter Graph](image)

**Figure 2.** Crude protein of pasture grass species across the grazing season

![Crude Protein Graph](image)
Forage quality was similar between cool season perennial pasture grasses and the warm season species evaluated in this study (Figure 3). Cool season pasture had higher average crude protein (23.0%) than the warm season grasses, but BMR sorghum sudangrass and teff grass still had adequate levels of protein for lactating cow diets (18.5 and 17.5%, respectively). Dry matter was higher in cool season pasture (23%) and teff grass (24%) than BMR sorghum sudangrass (20%). TTNDFD was similar between all types of forage. The mineral composition varied between the different grasses (Figure 4).

Figure 3. Forage quality of pasture grass species

![Average Forage Quality Characteristics](image)

Figure 4. Mineral composition of pasture grass species

![Average Mineral Composition](image)
There were no differences in milk production, components or quality between cows grazing only cool season pastures and cows in a system that incorporated warm season annuals. Average milk production was 32.3 lb for the cool system and 32.5 lb for the warm system. There was also no difference in body condition score, body weight, or activity between systems. Cows on cool season grasses did have higher daily rumination than cows in the warm season system. Cows in both systems follow similar trends in production including decreased production during times of high temperature and humidity. In 2015, cows in the warm system achieved higher production than cows in the cool system during July and August.

**Figure 5:** Milk production of cows in cool system and warm system across 2014 and 2015 grazing seasons

In the first year of the study, cows in the cool season system needed to be supplemented with stored feed in a TMR due to a shortage of forage biomass in pasture, while cows in the system incorporating warm season grasses were still able to graze. The following year there were no difference between pasture systems. Therefore, warm season annuals in grazing systems for dairy cattle may be beneficial in certain years to compensate for weather that affects pasture production.

Warm season grasses like BMR sorghum sudangrass and teff grass may be incorporated into a pasture system for grazing organic dairy cattle without sacrificing forage quality. Milk quality and production can also be maintained when warm season grasses are incorporated in a grazing system for organic dairy cattle. This study will be repeated for a third year to evaluate the economics of including warm season annuals in a pasture system compared to a system that uses only cool season perennials for organic dairy grazing operations. A continuation of this study is currently being conducted using a dual flow continuous culture fermenter, and results will include digestibility of the grasses used in this study.

**Conclusions**

Grazing systems using these different approaches to achieve diversity require biological, environmental and economic analysis. Pasture management and forage species selection within a farm can influence the forage quality of pasture forage for grazing dairy animals.

BMR sorghum-sudangrass and teff grass can be used in rotational grazing systems in the Midwest without sacrificing forage quality or milk production. Remember, sorghum-sudangrass and teff grass are not replacements for cool-season forages, but they should be added to a forage program to complement the cool-season grasses.

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