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Evaluation of fodder production systems for organic dairy farms

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ABSTRACT

This study evaluated the feasibility and challenges of implementing sprouted fodder on organic dairy farms. In study 1, 5 grains (barley, oats, wheat, rye, and triticale) were sprouted for 7 d and analyzed for yield and nutritional content. In study 2, lactating cows were fed a TMR during winter and supplemented with either no fodder or 1.4 kg (DM) of sprouted barley fodder. In study 3, 3 organic dairies that fed sprouted barley fodder were monitored monthly for 12 mo to collect data on feed nutritional analysis, milk production and composition, and management. Data from studies 1 and 2 were analyzed as separate replicated complete block designs, and study 3 was a case study. Barley and oats had the greatest ($P < 0.05$) fresh weight in study 1, oats had the greatest ($P < 0.05$) DM yield, and barley had the least ($P < 0.05$) mold score. In study 2, milk production, milk fat, BW, and BCS were not affected by supplemental fodder. Cows fed fodder had lesser ($P < 0.05$) milk protein production but greater ($P < 0.05$) milk urea N. Income over feed costs favored not feeding fodder except when cracked corn prices increased by 50% over those used in the study. In study 3, labor, cost of production, lack of milk response, barley supply, and mold issues resulted in 2 of the farms discontinuing fodder. Fodder increased milk production slightly on the third farm, probably due to decreased forage quality. Fodder may provide some benefits on small-scale operations, farms with high land values where tillable acreage can produce high-value crops, or for producers experiencing severe, extended drought. Additionally, farms that have an excess of labor may benefit with a sprouted fodder system. However, in many situations, growing high-quality forage would be more economical.

Key words: dairy, fodder, organic, sprouted barley

INTRODUCTION

Feeding sprouted grains is an old technology that is gaining renewed interest among dairy farmers in response to high grain prices, limited grain availability (especially in organic production), and challenges in producing high-quality forages. Traditionally, sprouted grain has been suggested as a method to produce fresh forage in areas where water shortages and seasonality of forages are common challenges for livestock producers (Rodriguez-Muela et al., 2005; Rodriguez, 2012). However, interest is also growing in temperate regions of the United States where producing high-quality forage has become more challenging due to changing weather patterns (drought or high intensity rainfall events) and a decline in availability of arable land (Nickerson et al., 2011; Griffin et al., 2014). Furthermore, increasing costs of grain in the organic sector, a desire for some dairies to move away from grain supplements, and an interest in an alternative solution to producing high-quality fresh forage year around have been cited as reasons for dairy farmers to consider using sprouting technology. Finally, manufacturers marketing sprouted grain systems have helped lead the reemergence in producer interest with high-profile trade-show appearances and internet videos claiming exceptional forage yields and increased animal health and performance. However, little scientific evidence is currently available to support these claims.

Previous research indicates that the benefits of sprouting may be negated by the total DM loss from sprouting coupled with no significant improvement in nutrient concentrations or digestibility (Dung et al., 2010; Hafla et al., 2014). Several studies have suggested that feeding sprouted grains may only increase performance in animals not receiving adequate protein, energy, or minerals (Thomas and Reddy, 1962; Sneath and McIntosh, 2003), or that the readily available nutrients in sprouted grains may stimulate enhanced utilization of poor quality forages (Tudor et al., 2003).

Currently, no information is available regarding the feeding value of sprouted grain with high-quality forages such as the conserved forages and pastures found on well-managed organic dairy farms in temperate regions of the United States. Therefore, the objective of this study was

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to evaluate the feasibility and challenges of implementing sprouted barley systems on organic dairy farms.

MATERIALS AND METHODS

The sprouted grain and lactating cow studies were conducted at the University of Minnesota West Central Research and Outreach Center (**WCROC**), Morris, Minnesota, and all animal procedures involving animal care and management were approved by the University of Minnesota Institutional Animal Care and Use Committee (#1404–31460A). The research dairy at WCROC has a 250-head low-input, certified organic grazing system. A FodderPro 3.0 commercial fodder system (FarmTek, Dyersville, IA) was used for the sprouted grain and lactating cow studies. The case study was conducted on 3 organic dairy farms in central Pennsylvania.

Sprouted Grain Study

During September 2014, 5 grains were evaluated for use in a fodder production system, and included barley (*Hordeum vulgare* L.), oats (*Avena sativa)*, wheat (*Triticum* spp.), rye (*Secale cereal)*, and triticale (× *Triticosecale*). Beginning each Monday for 6 consecutive weeks, 68 kg of each of the 5 grains were soaked separately in 284 L of water for 24 h. After soaking, 30 fodder trays (60 cm × 183 cm) were filled with 2.0 kg (DM) of wet grain. Each tray was automatically watered with the fodder system for 4 min, 3 times/d. On d 7, sprouted grains from each tray were harvested, weighed, and scored on a 0 to 5 scale for mold [0 = no mold, 1 = 20% of tray had mold (slight mold), 2 = 40% of tray had mold, 3 = 60% of tray had mold, 4 = 80% of tray had mold, 5 = 100% of tray (severe mold)]. Ten random samples from each sprouted grain each week were dried for DM analysis immediately and then frozen at −20°C until analysis for OM, CP, NDF, ADF, starch, and minerals using wet chemistry by Rock River Laboratories Inc. (Watertown, WI).

Lactating Cow Study

From June 2 to August 11, 2015, 36 spring-calving lactating cows at the WCROC organic dairy were used to evaluate production, profitability, and milk fatty acid (**FA**) profile of cows supplemented with sprouted barley fodder. The cows were a combination of multiparous (n = 22; milk = 15 ± 4.6 kg/d; DIM = 85 ± 30 d) and primiparous (n = 14; milk = 12 ± 2.5 kg/d; DIM = 63 ± 21 d) at the beginning of the study. Sprouted barley fodder was chosen based on the results from the sprouted grain study previously described and because certified organic barley seed was readily available in the Midwest. Methods for growing and harvesting the sprouted barley are the same as described in the sprouted grain study above with the exception that trays were started every day, not just on Mondays as in the grain study. Cows were assigned to 1 of 2 treatments (2 replicates per treatment, n = 9 cows per replicate; 2 groups of 9 cows each were fed fodder and 2 groups of 9 cows each were not fed fodder) and were blocked by lactation number, DIM, breed, and previous lactation milk production. Breed groups of cows included pure Holsteins and various crossbreds of Jersey, Normande, Holstein, Montbéliarde, and Swedish Red; breed groups were balanced across treatment groups and replicates.

Cows were fed the following dietary supplementation levels: (1) no fodder supplementation or (2) fodder supplementation at 1.4 kg of DM/cow per d. Supplement (including the fodder) was fed with a TMR that included corn silage, alfalfa silage, and the corn–grain mix. On a DM basis, the fodder replaced 2.42 kg of DM of cracked corn. The no-fodder cows were fed 3.23 kg of DM of cracked corn in the supplement. The TMR was mixed on site at WCROC and contained (on a DM basis) 36.9% DM (fodder group), 47.1% DM (no fodder), 14.8% CP, 34.5% NDF, 2.9% crude fat, 1.23% calcium, 0.43% phosphorus, 34.8% nonfiber carbohydrate, and 23.3% starch. Daily feed consumption by each replicated group was monitored as the difference between feed offered and refused, using a TMR feeding wagon equipped with Feed Supervisor herd management software (Supervisor Systems, KS Dairy Consulting Inc., Dresser, WI). Cows were kept in separate replicated groups 24 h/d for the entire 70 d of the study, and the 4 cow groups (9 cows each) were brought separately to the milking parlor for the morning and evening milkings throughout the study.

Body weights were recorded once every 2 wk using a digital scale as cows exited the milking parlor after the morning milking. Body condition scores were visually assessed by one observer at the same time as BW, using the following scale: 1 = excessively thin to 5 = excessively fat (Wildman et al., 1982). Milk production was quantified with daily data collection from the BouMatic SmartDairy system (BouMatic, Madison, WI) at the WCROC dairy. Milk samples with DHI measures were collected once every 2 wk and analyzed for milk components [fat %, protein %, SCC, and milk urea N (**MUN**)] with mid-infrared spectrophotometry (5000 Combi-Foss Milk Analyzer, Foss North America, Eden Prairie, MN).

Group milk samples (by treatment and replicate) were collected using the QMI Safe Septum sani-elbow milk-line sampling device (Godden et al., 2002) and analyzed for FA profile once every 2 wk at the Minnesota Valley Testing Laboratories (New Ulm, MN) according to the AOAC International method (AOAC International, 2006; method 996.06). Lipids were extracted from a 3-g sample of milk. Lipids were extracted in ether and then methylated to FA methyl esters using bromine trifluoride in methanol. The FA methyl esters were quantitatively measured by capillary gas chromatography against the triundecanoin standard. Total fat was calculated as the sum of individual FA expressed as triglyceride equivalents, and saturated and unsaturated fats were calculated as the sum of their respective FA. Results were reported as a percentage of a

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