

## Research Paper

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# An overview of organic, grassfed dairy farm management and factors related to higher milk production

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## Abstract

Organic, grassfed (OGF) dairy, which requires higher pasture and forage dry matter intake compared with standard organic dairy practices, is unique both in its management needs and in production challenges. The OGF dairy sector is rapidly growing, with the expansion of this industry outpacing other dairy sectors. There is a lack of research outlining OGF dairy production practices, producer-identified research needs or social factors that affect OGF systems. The objectives of this study were to, with a group of OGF dairy producers, (1) assess information regarding current production practices and producer knowledge, and (2) identify agronomic and social factors that may influence milk production on OGF farms across the United States. A mail survey, focused on demographics, forage and animal management, knowledge, and satisfaction of their farm, was developed and distributed in 2019, with 167 responses (47% response rate). The majority of producers indicated they belonged to the plain, or Amish-Mennonite, community. Milk production was greater on farms that had Holstein cattle, as compared to farms with Jerseys and mixed breeds, and employed intensive pasture rotation. Furthermore, most producers reported the use of supplements such as molasses and kelp meal, which can improve milk production, but also increase feed costs. Producers who indicated that they were at least satisfied with their milk production also reported high levels of knowledge of grazing management and cow reproductive performance. Comparison of response data from plain/non-plain respondents revealed that those that did not identify as plain were more likely to utilize certain government programs, had different priorities and utilized technology more frequently. Based on these results, more research exploring financial and production benchmarks, effective communication strategies to reach OGF producers and methods to improve cattle production through improved forage quality is needed.

## Introduction

During the last decade, organic dairy production has increased rapidly in the United States with the consumer market for organic milk growing from 1.9 to 5.0% of total milk sales (USDA-AMS, 2020). While organic livestock typically produce less milk than conventionally-raised animals, producers have historically captured higher milk prices to offset increased input costs (Su *et al.*, 2013). Organic dairy producers are now facing declining milk prices due to an oversupply of milk. As of 2019, total organic milk products declined by 2.2% (USDA-AMS, 2020). However, the organic, grassfed (OGF) milk market continues to show high demand leading to an increase in grassfed livestock production, particularly in the northeastern USA (USDA-NASS, 2017). Grassfed, for the purposes of this study, is defined as dairy production relying on forages (pasture and conserved forages), without grains, to meet nutritional needs. This specialized system, to be certified OGF, must also comply with organic standards as well as a unique set of regulations specific to grassfed dairy.

Existing research suggests that, to secure the future of their farms, producers are choosing to adopt grassfed feeding systems in part due to economics, but also due to other reasons, including personal philosophy, health/safety and environmental sustainability (Flaten *et al.*, 2006; Bouttes *et al.*, 2019). In a Norwegian study, Flaten *et al.* (2006) grouped 161 organic dairy producers in three different categories: early organic farming entrants (certified organic since 1995 or earlier), midconverters (certified organic between 1996 and 1999) and late

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converters (certified organic since 2000 or later). All groups ranked environment, sustainability and the production of high-quality food as their main motivators, although those who transitioned later ranked economics as a major motivator as well. Bouttes *et al.* (2019) found that organic producers were motivated to switch from conventional management to achieve increased professional satisfaction as competitive organic milk prices enabled them to reduce the number of cows and workload.

Navigating regulatory policies of the transition process is also commonly perceived as a challenge in the OGF dairy industry. Organic and grassfed dairy are similar in management but have different regulations that dictate some aspects of the production system. This includes livestock feeding requirements, which could directly influence milk production. As per regulations set forth by the USDA National Organic Program (USDA-NOP, 2020), organic dairy cattle over the age of 6 months must receive 30% or more of dry matter intake (DMI) from pasture during the grazing season for a period of at least 120 days. It is further mandated that OGF livestock must be on pasture at least 150 days and receive 60% or more of their DMI from pasture (Organic Trust Plus Inc., 2019). Supplements and feed additives without grain components may also be utilized under strict guidelines. Compliance with these regulations can create challenges on OGF dairies, particularly due to the nutritional reliance on forages and potential limitations in pasture productivity and quality (Brito and Silva, 2020; Wilkinson *et al.*, 2020).

Research supporting grassfed dairy operation needs is currently outpaced by the sector's expansion, creating knowledge gaps for both producers and the allied industry. Demographic (McBride and Greene, 2009), management (Stiglbauer *et al.*, 2013) and research and education needs (Pereira *et al.*, 2013) regarding organic dairy production have been previously reported as having perceptions of consumers (Pirog, 2004) and grassfed dairy producers in Europe (Läpple, 2013). There is currently limited research exploring grassfed dairy industry characteristics and social factors that may influence milk production and management decisions in the USA. Our research utilized a nationwide survey of OGF dairy producers to improve the understanding of this farming demographic and their characteristics. Therefore, the objectives of the current study were to (1) assess information regarding current production practices and producer knowledge, and (2) identify agronomic and social factors that may influence milk production on OGF farms across the United States.

## Materials and methods

### Survey questionnaire

A survey was developed in 2019 with the aim of recording information about OGF producer characteristics, attitudes and perceptions. The survey was developed through a multidisciplinary research team in collaboration with a producer advisory group and industry feedback. Institutional Review Board approval was obtained prior to beginning the research from the University of Vermont (IRB # 00000036). We utilized the Dillman tailored design approach to disseminate the survey to 351 farms from a list of producers obtained from dairy cooperatives located in New York and Wisconsin (Dillman *et al.*, 2016). A postcard first announced the survey, followed by the survey instrument, and a reminder postcard. A second survey was sent to any non-respondents one month later. A total of 167 respondents returned the survey, with three undeliverable, three out of sample as their

cattle had been sold, and one explicit refusal, resulting in a response rate of 46.8% according to the American Association for Public Opinion Research calculation methodology (AAPOR, 2015).

### Survey instrument and variables

The survey consisted of multiple sections including (1) general farm information, (2) herd management and (3) forage and grazing management. The questions utilized in the statistical analysis are included in Supplementary Table 1, including descriptive statistics. All variables included were specific questions from the survey, apart from the Information Scale, which was an aggregated score of all responses for sources of dairy information and frequency (Cronbach  $\alpha = 0.82$ ).

### Statistical analysis

Data were analyzed in Stata 16.0 (Stata 2019), utilizing descriptive statistics and multivariable analysis. Relationships were analyzed using Pearson correlation coefficients with statistical significance declared when  $P \leq 0.05$ . Results were interpreted as a weak association being 0.1 to 0.3 or  $-0.1$  to  $-0.3$ , medium association at 0.3 to 0.5 or  $-0.3$  to  $-0.5$ , and strong at 0.5 to 1.0 or  $-0.5$  to  $-1.0$ . A multivariable regression analysis was conducted, first utilizing step-wise regression analyses. We conducted seven separate step-wise regression models focused on characteristics relating to animals, forage management, policy, on-farm management, demographics, producer knowledge and information (Table 1). Factors from individual models were considered significant when  $P \leq 0.10$  and used in the final full multivariable regression model to determine influence on milk production. Factors from the multivariable regression model were considered significant at  $P \leq 0.05$  and are reported in their respective sections below as it relates to milk production. Model results for all step-wise regression models are included in Supplementary Tables 2, 4–6, 8, 9 and 11. Post-hoc analysis was also performed to identify any relationship between survey response data and self-identification by respondents belonging to the plain community. These relationships were analyzed in SAS 9.4 (SAS Institute) using the PROC FREQ procedure with two-sided  $\chi^2$  tests. Values were considered significant at  $P \leq 0.05$ .

## Results

### Descriptive statistics

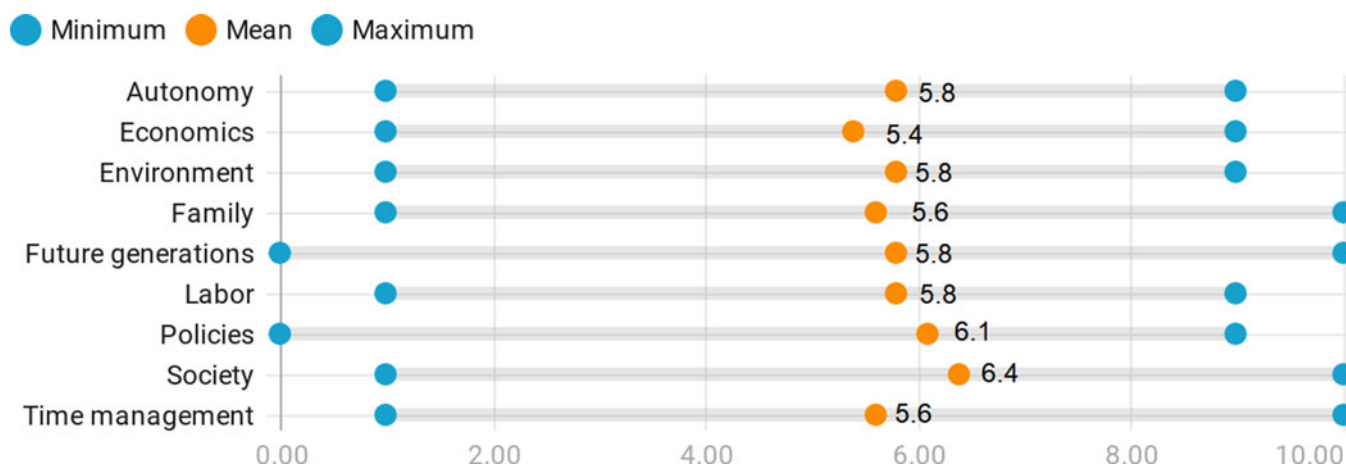
#### Producer demographics and on-farm decision-making influences

Geographically, the largest number of responses (49.7%) were received from OGF dairies located in New York (81 farms). The remaining responses were received from OGF dairies located in 15 states with the majority located in the Northeastern [Pennsylvania (6.1%), Vermont (6.1%), New Hampshire (1.2%), New Jersey (0.6%) and Massachusetts (0.6%)] or Midwestern [Ohio (11.7%), Wisconsin (7.9%), Iowa (3.7%), Minnesota (1.8%), Kansas (0.6%) and Indiana (0.6%)] USA (Supplementary Fig. 1). Outside of the Northeast and Midwest, remaining responses were received from Maryland (3.7%), Virginia (2.5%), Florida (0.6%) and Oregon (2.5%). Demographically, producers predominantly identified as being the farm owner (91.5%), male (91.4%), and as belonging to the plain, or Amish and Mennonite, community (61.0%; Supplementary Table 2). Respondents indicated that they had

**Table 1.** Full multivariable model, following seven stepwise models, predicting milk production per cow

Variable	Coefficient	Standard error	P-value	95% Confidence interval	
Holstein	1574.95	425.95	0.00	732.08	2417.83
Grazing season	-6.16	5.71	0.28	-17.46	5.15
Twice a day	741.44	513.78	0.15	-275.24	1758.13
Supplements	504.35	351.41	0.15	-191.03	1199.74
Grazing knowledge	-283.21	227.79	0.22	-733.96	167.54
Reproduction knowledge	578.27	215.85	0.01	151.13	1005.40
Information scale	1036.45	296.48	0.001	449.78	1623.12

$R^2 = 0.31$ ,  $n = 135$ .



**Fig. 1.** Respondent ranking of factors that influence on-farm decisions. Responses are based on a scale from 0, being the most influential, to 9, being the least influential. Values are expressed as the mean with the minimum and maximum response range.

been dairy farming for  $21.4 \pm 15.1$  years with a mean age of  $47.6 \pm 12.9$  years.

Respondent ranking of factors that influence on-farm decision-making is shown in Figure 1. When producers compared the self-perceived status of their farm to similar farms on a scale from significantly worse to significantly better, 79.3% indicated that they were at least somewhat better compared to other dairies, whereas 19.3% said that they felt they were doing worse than other farms. Based on responses, autonomy, environment, labor and future generations were of equal influence regarding on-farm decision-making across the entire sample. This is also reflected by the number of producers that have succession plans; only half of producers stated that they had at least a partial succession plan. However, when assessing farm priorities by a respondent who is identified as part of the plain community (termed plain producers herein) vs those that did not (termed non-plain producers herein), family and well-being was more influential to non-plain producers ( $P = 0.02$ ). Autonomy was considerably more important to producers identifying as plain producers ( $P = 0.03$ ) whereas economics was considered more important by non-plain producers ( $P = 0.03$ ). Both plain and non-plain producers ranked economics as the greatest influence for decision-making with an average importance of  $5.4 \pm 2.8$ , on a scale from 1 to 9. However, impacts on society (neighbors, community) and policies and regulations proved to be slightly less influential with averages of  $6.4 \pm 2.4$  and  $6.1 \pm 2.5$ , respectively. Non-plain producers indicated that while policy was not as influential on their

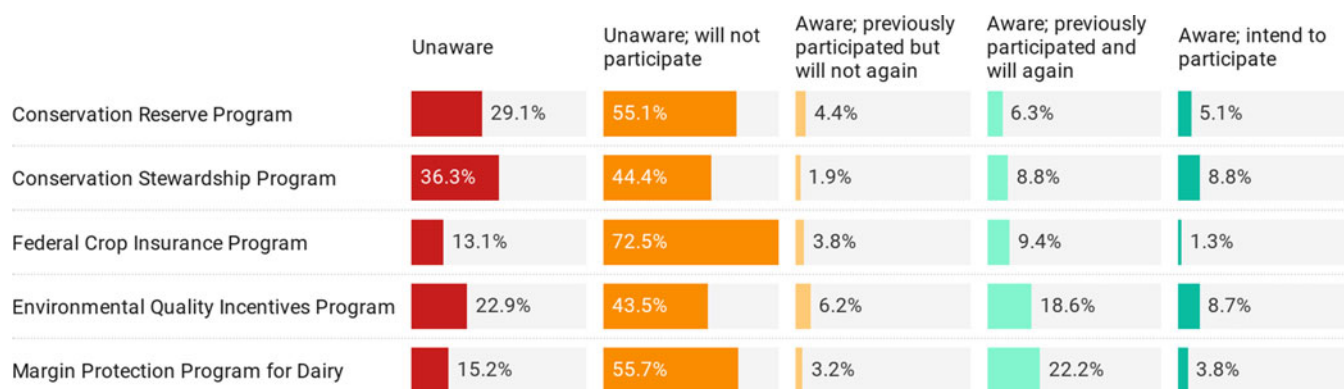
decision-making, they still held it in higher regard than plain producers ( $P = 0.04$ ; Supplementary Table 3).

#### Federal programs and policy factors

The questionnaire included questions about participation in nationally recognized programs, including organic and grassfed certifications, and government cost-share programs such as the Conservation Reserve Program (CRP) and Federal Crop Insurance Program (FCIP). Responses are summarized in Figure 2 and Supplementary Table 4. Most producers were either unaware (23.3% of respondents) of these programs or were aware but did not intend to participate (54.2% of respondents). Non-plain producers were more likely to utilize the Environmental Quality Incentives Program (EQIP;  $P < 0.0001$ ) and Margin Protection Program for Dairy (MPPD;  $P < 0.0001$ ) than plain producers. Producers indicated that they utilized both organic certifiers and organic educational organizations, their milk buyer/cooperative, producer publications and other dairy producers monthly or a few times a year for sources of dairy information. On average, 96.3% of farms that responded were certified organic for  $10.3 \pm 7.2$  years or as OGF for  $5.1 \pm 4.5$  years.

#### Herd characteristics and management

The predominant genetics represented on-farm reported by respondents were crossbred (54.1%), Holstein (21.7%) and Jersey (7.2%). On average, producers had 49 milking cows and



**Fig. 2.** Utilization of United States Department of Agriculture (USDA) programs by organic, grass-fed dairy productions surveyed in spring 2019. Responses are based on a scale from unaware to aware and intending to participate. Values are expressed as a percentage.

**Table 2.** Ranking of satisfaction of production parameters by organic, grassfed (OGF) producers across the United States surveyed during the spring of 2019

Rank <sup>a</sup>	Very unsatisfied	Unsatisfied	Somewhat unsatisfied	Somewhat satisfied	Satisfied	Very satisfied
Farm income	3.1	8.8	20.1	37.1	25.2	5.7
Herd health	0.0	1.9	6.2	29.8	43.5	18.6
Cow body condition	0.0	3.7	9.8	31.1	41.5	14.0
Reproduction and calving	0.6	4.3	17.2	30.7	36.2	11.0
Quality of young stock	1.9	2.5	7.4	30.3	41.4	16.7
Pasture quality and yield	0.0	8.0	14.7	46.6	24.5	6.1
Stored forage quality	0.0	6.4	16.7	35.3	32.1	9.6
Stored forage yield	2.0	7.8	18.8	37.7	29.2	4.6
Soil fertility/health	0.6	7.5	19.4	40.0	28.8	3.8

<sup>a</sup>The results of 167 surveys were analyzed and ranked according to producer satisfaction. Producers were asked to rank their satisfaction with various production parameters on a scale from very unsatisfied to very satisfied. Values are expressed as percentages of total respondents.

an average of 10 dry cows. The calculated average age of cows in a herd was  $5.7 \pm 1.4$  years old. The results of producer satisfaction are summarized in Table 2 and management characteristics in Supplementary Tables 5 and 6. Regarding herd health parameters such as body condition score, animal health, young stock quality, and reproduction and calving, most producers were at least somewhat satisfied with body condition, herd health and young stock quality. Plain producers reported that they were more satisfied with their soil fertility ( $P = 0.05$ ), reproduction and calving ( $P = 0.05$ ) and quality of youngstock ( $P = 0.003$ ) than non-plain producers. Producers indicated that they cull  $16.2 \pm 8.5\%$  of cows on a yearly basis with four major reasons being reproduction (58.1%), injury or health (35.3%), mastitis (34.7%) and milk quality (30.5%). However, there were no relationships between farmer demographics with culling and age ( $P = 0.71$ ), years farming ( $P = 0.09$ ), number of milking cows ( $P = 0.31$ ) or total hectares managed ( $P = 0.79$ ) (Supplementary Table 7).

#### Land and forage management

There was a strong positive relationship between the number of total acres managed and the number of milking cows ( $R = 0.57$ ); as the total number of hectares managed increased, the number of milking cows increased ( $P < 0.001$ ). Producers managed

$108.3 \pm 74.8$  hectares of land and owned  $74.7 \pm 55.4$  hectares or rented  $49.7 \pm 43.7$  hectares. Of the land being utilized,  $88.8 \pm 64.5$  hectares was used for pasture and growing perennial and annual forages. However, most producers did not typically grow annual forage crops such as sorghum sudangrass. Those producers who did utilize annual forages indicated that they grew  $7.4 \pm 7.9$  hectares/year. Results are further summarized in Supplementary Table 8.

#### Farmer knowledge

A total of 93.1% of producers indicated that they believe they have at least an average knowledge regarding grazing management systems (Table 3; Supplementary Table 9) and managed their land for species diversity through grazing management strategies. A typical grazing season lasted  $196.8 \pm 32.2$  days on average with animals receiving between 70 and 90% of DMI from pasture. Producers indicated that their grazing seasons lasted at minimum 140 days and 360 days at maximum. In addition to growing their own stored forages, 63.9% of producers also purchased  $38.3 \pm 29.1\%$  of their total forage needs. Plain producers were more likely to purchase forages ( $P < 0.0001$ ). A moderately negative relationship ( $R = -0.32$ ) was observed between the amount of forage purchased and total hectares managed; as the amount of forage



**Table 3.** Ranking of self-perceived knowledge of production parameters by organic, grassfed (OGF) producers across the United States surveyed during the spring of 2019

Rank <sup>a</sup>					
Production parameter	Very low	Low	Average	High	Very high
<b>Herd health</b>					
Body condition scoring	1.2	6.2	63.0	20.4	9.3
Reproductive performance	0.6	14.3	49.7	24.8	10.6
<b>Forages and grazing</b>					
Cow energy requirements	0.6	6.9	62.9	24.5	5.0
Grazing management systems	0.6	6.3	38.4	40.3	14.5
Growing higher energy forages	1.3	15.8	48.7	28.5	5.7
Improving forage quality	0.0	6.3	50.0	36.7	7.0
Forage yields	0.6	15.6	50.0	24.4	9.4
Understanding forage test results	2.6	23.1	44.2	23.7	6.4
Forage DMI strategies	1.9	16.5	47.5	27.9	6.3
Forage production costs	1.9	22.2	55.1	15.8	5.1
<b>Record keeping and interpretation</b>					
Farm record keeping	0.0	7.4	53.7	25.3	13.6
Understanding MUN results	3.8	14.5	37.7	33.3	10.7
Understanding soil test results	1.3	22.0	49.1	20.8	6.9

<sup>a</sup>The results of 167 surveys were analyzed and ranked according to self-perceived producer knowledge. Producers were asked to rank what they believed they knew regarding various production parameters on a scale from very low to very high. Values are expressed as percentages of total respondents.

purchased increased, the total amount of hectares managed decreased ( $P = 0.001$ ).

In the current study, producers were asked about perceived knowledge in growing forages, understanding forage test results, production costs and feed supplementation practices. Approximately 82.9% of respondents reported at least an average knowledge of growing higher-energy forages. Producers also said that they understood the energy requirements of cows according to production levels and were at least somewhat satisfied with their pasture quality and yield (77.3%;  $P = 0.01$ ), stored forage quality (76.9%;  $P = 0.003$ ) and stored forage yield (71.4%;  $P = 0.003$ ; Supplementary Table 10). Respondents (25.6%) indicated that they had a very low or low knowledge regarding forage test result interpretation with similar responses reported about strategies to maximize forage DMI and forage production costs. Plain producers indicated that they were more knowledgeable than their non-plain counterparts regarding the interpretation of forage test results ( $P = 0.002$ ), growing high-energy forages ( $P = 0.03$ ), grazing management ( $P = 0.002$ ) and cattle energy requirements ( $P = 0.02$ ). However, there were no perceived knowledge differences between plain and non-plain producers regarding forage quality ( $P = 0.11$ ).

#### Farmer sources of information

Producers identified key sources of dairy information that influenced their on-farm decision-making. Sources of information included community papers and producer publications, organic certifiers and educational organizations, the USDA, extension groups, feed dealers, consultants, other dairy farmers and milk cooperatives. On a scale from never to daily, producers were asked to identify which sources they utilized the most and

found to be most helpful. Private consultants (72.7%) and Farm Bureau (77.6%) were least likely to be utilized, whereas milk cooperatives (90.3%), producer publications (90.3%) and other dairy producers (97.48%) were used as information sources at least a few times a year. Overall, the use of outside sources of information was found to influence milk production in both the step-wise model ( $P = 0.001$ ; Supplementary Table 11) and the full model ( $P = 0.001$ ).

#### Identified agronomic and social influences on milk production

##### Animal and herd characteristics

In describing OGF herd milk production and milking seasonality, herds were typically milked at least twice daily (84.9%) with an average annual milk production of  $4220.6 \pm 1044.9 \text{ kg cow}^{-1}$ . Results indicate that belonging to the plain community had no bearing on milk production ( $P = 0.47$ ). Producers (72.0%) indicated that they were at least somewhat satisfied with their current milk production ( $P = 0.01$ ). A total of 84.8% of respondents reported that their herd produced milk year-round while 15.2% identified as seasonal milking herds. In this study, if seasonal milk production was utilized, the herd dry-off period most frequently occurred between February and March, followed by July and August, and January and February.

As is typical of pasture-based systems, most producers fed their cattle approved energetic supplements or byproducts. Sugar or molasses were the two most commonly utilized feed supplements with 41.4% of surveyed producers stating they utilized energy sources year-round. Other producers indicated that they supplemented as needed during the winter season (29.9%) or during the grazing season (4.6%). Besides molasses and sugar, producers

were also utilizing supplements such as minerals, salt, sodium bicarbonate, clay, yeast, probiotics and kelp meal, as well as less-commonly utilized products such as apple cider vinegar and dried carrots. We completed seven separate individual step-wise models (Supplementary Tables 2, 4–6, 8, 9 and 11), which indicated the following significant relationships to milk production: (1) Holstein breed associated with higher milk production ( $b = 3357.36$ ,  $P = 0.001$ ), (2) milking twice a day associated with higher production ( $b = 1577.11$ ,  $P = 0.006$ ), (3) use of energy supplements associated with higher production ( $b = 964.74$ ,  $P = 0.02$ ), (4) length of grazing season associated with lower milk production ( $b = 31.11$ ,  $P = 0.03$ ), (5) producers with higher levels of grazing management associated with lower milk production ( $b = -734.08$ ,  $P = 0.02$ ), (6) producers with higher levels of reproductive performance management associated with higher milk production ( $b = 534.87$ ,  $P = 0.06$ ), and (7) producers with greater frequency and number of dairy information sources associated with higher milk production ( $b = 1218.97$ ,  $P = 0.000$ ). The full multivariable model (which incorporated only the statistically significant results from each of the stepwise regression models) indicated that Holstein cow use ( $b = 1574.95$ ,  $P < 0.001$ ), reproduction knowledge ( $b = 578.27$ ,  $P = 0.008$ ) and greater frequency and depth of dairy information (Information Scale;  $b = 1036.45$ ,  $P = 0.001$ ) were all positively associated with per cow milk production ( $R^2 = 0.31$ ).

## Discussion

We aimed to better understand the characteristics and perspectives of OGF dairy producers across the USA, and identify the factors related to higher milk production in OGF dairy herds. Overall Holstein cows, producers with higher knowledge of reproduction, and greater frequency and depth of dairy information sources were found to be positively associated with milk production. Given that pasture-based cows typically produce less milk than those fed in confinement due to less control over nutrient intake (Kolver, 2003), our findings provide a guide for the OGF industry to better understand its capacity to increase production. The reported average milk produced in our study was lower than that of confined and traditional organic (but not grassfed) dairy herds reported in the survey of McBride and Greene (2009), likely because OGF cows are not permitted to be fed supplemental grains. However, other factors may contribute to lower milk production in OGF systems. Responses provided by US OGF dairy producers have for the first time given insight into production and management practices of this production system. Furthermore, there is now a better understanding of the agronomic and social factors that influence milk production and on-farm decision-making on OGF dairies. Below we discuss further demographics, management and knowledge findings, as well as the factors related to higher milk production.

### Demographic factors

The distribution of OGF producers who responded to our survey aligns with data reported by the 2017 USDA-NASS Certified Organic Survey and previous research by McBride and Greene (2009), whereby New York represented the state with the greatest number of certified organic farms, followed by Wisconsin, Pennsylvania, Indiana, Ohio and Vermont. Little information is available about the geographic distribution of purely grassfed producers but a study by Weber *et al.* (2008) indicated that grassfed

producers were located in all regions of the USA. In the current study, OGF farms were most concentrated in the Northeastern and Midwestern USA due to proximity to dense human populations, diverse milk markets, infrastructure for handling OGF milk and OGF milk buyers (Flack, 2016); however, these geographic distributions also likely reflect our sample size based on lists obtained from partner cooperatives.

The large proportion of respondents indicating they belonged to the plain community in this study aligns with reported geographical data as higher densities of Amish communities are located in the Northeastern and Midwestern USA (Cross, 2016), and also may explain the low levels of reported technology use for record keeping and finances. Furthermore, plain producers were less likely to participate in government programs, and exhibited different on-farm priorities. These findings are important because it suggests that the organic dairy industry needs to communicate and develop benchmarks for the plain community using non-electronic mechanisms and provide technical assistance outside of government programs. McBride and Greene (2009) found similar results with organic dairy producers; based on their survey results, 41.0% of organic dairy producers utilized information from the Internet, whereas only 21.0% utilized on-farm computer records. In their study, several technologies and practices tended to increase with the size of the organic operation and with higher education (McBride and Greene, 2009); however, we did not account for education level in the current study.

### Management factors

Regarding herd health and culling practices, similar to our results, Rozzi *et al.* (2007) found that two main reasons organic producers culled animals were poor fertility and mastitis. Additionally, Ahlman *et al.* (2011) compared dynamics of culling reasons between conventional and organic herds and reported no genotype  $\times$  environment interactions for longevity. However, it was determined that the main reason for culling in organic herds was due to poor udder health, whereas fertility issues were the main cause in conventional herds. Furthermore, culling occurred at a younger age in organic herds. This directly contradicts the findings of both Mullen *et al.* (2013) and Stiglbauer *et al.* (2013). Mullen *et al.* (2013) found that organic farms and conventional farms utilizing grazing typically kept animals that were older, which are generally associated with mastitis, foot problems and milk fever. Stiglbauer *et al.* (2013) also determined that organic farms kept older cattle, although in their study, there was a trend of younger animals on conventional, non-grazing operations. It should be noted that culling decisions are complex, requiring knowledge of current animal status and predicted performance. In OGF operations, decisions also rely on compliance with grassfed rules and certain ethical standards, meaning that antibiotics cannot be utilized when dealing with mastitis or udder health. Therefore, the reasons provided by producers for culling in our survey may depend on what the producers find acceptable which could be different from conventional producers.

### Social influences

Both plain and non-plain producers ranked economics as their greatest influence for decision-making. Family and well-being were more influential to on-farm decision-making to non-plain producers as was economics. This could be related to the number of producers that had succession plans, which, in turn, provides

potential security for their families. Of the surveyed producers, 54.8% said they did not have a succession plan. These results align with Brock and Barham (2013) where dairy producers also indicated economics to be one of the primary forces behind decision-making. Organic grassfed producers in the current study reported similar drivers for on-farm decision-making, with economics, environmental reasons and health being the major influences. Producers also noted that they were not interested in participating in government-sponsored programs, which was similar to the results presented by Hanson *et al.* (2004). Hayden *et al.* (2018) suggested that organic producers feel at odds with normal farming practices and, therefore, did not feel valued as highly by financing, insurance and regulatory institutions. This, in turn, could lead to a distrust in government-based programs. Additionally, there is speculation that producers feel as though some government programs are not adequately promoted and are not adaptive enough (Hayden *et al.*, 2018). For example, a significant proportion of OGF producers in this study indicated they had no knowledge of these programs, which may also be related to the high percentage of producers in OGF dairy that belong to the plain community, who may have an aversion to federal programs based on personal philosophy. One specifically important finding was the extent to which producer frequency and number of dairy information sources positively correlated with milk production, which agrees with previous research (Lubell *et al.*, 2014). These results indicate that dairy producers may be getting a diversity of information across varying sources from other farmers to extension to industry professionals, all of which may help them identify practices to improve their productivity.

### Farmer satisfaction and knowledge

The results of this study indicated that the length of the average grazing season was approximately 197 days, which is longer than expected considering the weather conditions of the Northeast and Midwest. Similar to Pereira *et al.* (2013), despite most producers being located in the Northeast and Midwest, surveyed OGF dairies in this study indicated they operated on a year-round basis, rather than seasonally. This could potentially be due to the use of annual forages to extend the grazing season. However, our results indicated that the use of annual forages and year-round grazing operations did not have a relationship ( $P=0.17$ ) as most producers did not utilize annuals in this study. The length of grazing season could potentially be related to the amount of forages purchased. As previously stated, approximately 64% of producers purchased forages to supplement grazing diets. Producers supplemented their diets with an average of 38.3% purchased forages although amounts ranged from 0.33% of the diet to 100%. This is similar to Pereira *et al.* (2013) who reported that 73% of organic farmers purchased feed from off-farm sources. However, in this study, there was no relationship between grazing seasonality and whether producers purchased forages or not ( $P=0.65$ ).

A large portion of OGF producers indicated that they were satisfied with their pasture quality, yield, and milk production. The majority also indicated that they only had an average knowledge about factors (i.e., growing higher-energy forages, forage improvement and quality, forage DMI) that could affect pasture utilization and milk production. This suggests that OGF producers may be prioritizing other management practices and do not see a need to focus on forage quality and milk production. For example,

Pereira *et al.* (2013) assessed research needs and topics of priority of Northeastern organic dairy farmers. Respondents indicated that although obtaining a steady, fair milk price and improving forage production was important to them, there were other priorities, such as integrated pest management, that were just as valuable.

Because OGF producers may be prioritizing factors other than milk production and forage management, based on survey responses, it is possible that they are not supplying cows with high-quality forage to meet energetic demands. Energy intake is dependent on DMI and dry matter energy value (Van Vuuren and Van Den Pol-Van Dassel, 2006). Lower DMI in pasture-based systems is one of the main limiting factors for milk production as this affects metabolizable energy supply (Kolver, 2003). In our study, DMI as reported by producers was not a significant factor relating to milk production but this could be due to other on-farm factors such as length of grazing season and management intensity (Weiss and Jeltsch, 2015).

Approved non-grain, energy sources and feed additives are utilized in OGF systems. One such supplement is molasses, as it is palatable, energy-dense, and approved for organic dairy production (Soder *et al.*, 2011) and by some grassfed labels (American Grassfed Association, 2018). Producers reported greater milk yield with energy supplements, as well as greater satisfaction with their milk production but still reported using energy-based supplements year-round, which, depending on the supplement, could prove costly, as compared to using high-energy forages (Soder *et al.*, 2011). Kelp meal was also commonly utilized by respondents (72.5%) in this survey. Although more costly, according to Antaya *et al.* (2015), organic dairy producers have anecdotally linked kelp meal to improved body condition score and animal appearance, decreased milk somatic cells count, and control of nuisance flies. Previous surveys conducted in the Northeast (Antaya *et al.*, 2015) and Midwest (Hardie *et al.*, 2014; Sorge *et al.*, 2016) revealed that between 49.0 and 83.0% of organic dairy producers feed kelp meal, thus consistent with our results.

Forage quality and quantity was a common issue as home-grown forages were lacking in either amount or quality. Utilization of energetic supplements and outsourced forages could suggest a forage quality issue, leading to a dietary deficiency. The need to purchase additional forages could also be due to resource constraints or inappropriate stocking rate/density, both of which can affect forage quantity and quality. Economic viability may also play a role as producers in our study indicate they are highly driven by economics; purchasing forages represents a lower initial investment relative to growing forages, which could be economically advantageous.

Reproduction, genetics and breed type had an influence on milk production. In our study, farms comprised of Holstein cows reported that they had the greatest milk production. These results are similar to Coffey *et al.* (2016) who found that Holstein herds in seasonal calving systems had a greater milk production than Friesian and Jersey herds. Jersey was found to have greater milk protein and fat concentrations, whereas Holstein had lower concentrations (7.75%), similar to data presented here in which the average concentration of milk fat and protein combined was 7.77%. Apart from breed, reproductive performance knowledge correlated with increased milk production, which agrees with the suggestion that OGF producers are prioritizing factors other than forage management. The economic impact of reproductive performance and knowledge makes management a key priority to producers (Denis-Robichaud *et al.*, 2018), thus

consistent with the finding that a large proportion of culling decisions are made based on cow reproductive status. Denis-Robichaud *et al.* (2018) reported that dairy reproductive performance was one of the most important priorities for research. However, unlike the producers in the current study, almost half of the producers in the study by Denis-Robichaud *et al.* (2018) were not satisfied with their milk production. This could indicate that because OGF dairy producers prioritize reproductive performance, and possible health and welfare, more so than other factors, they may not encounter the same challenges as conventional producers.

## Conclusions and implications

Results of this study showed a need for further research to develop financial and production benchmarks that will aid OGF dairy producers in improving management practices thereby enhancing economic sustainability on their operations. However, traditional methods of communication and outreach may not reach a significant portion of OGF dairy producers from the plain community who do not utilize modern information technologies. This is an important finding, especially because greater frequency and diversity of information sources were found to positively associate with animal production. Future efforts must focus on a wider range of outreach to better meet the educational needs of OGF dairy producers through a broader array of methods to disseminate information. Additionally, the results of this study revealed a high level of misunderstanding and disconnect, specifically in the areas of producing high-quality forage, meeting energy needs of OGF dairy cows, feed supplements and their implications to overall animal productivity and farm profitability.

In addition to creating financial and production benchmarks, our results revealed knowledge gaps in the areas of forage quality, forage energetics, feed supplements and their implications to grazing nutrition. These identified critical areas indicate that research needs to be developed to determine forage energetics and help producers create pasture plans that will ensure that their animals receive nutrient and energy-dense forages. Future research efforts are needed to better meet the educational needs of OGF dairy producers through a broader array of methods to disseminate information.

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## References

Ahlman T, Berglund B, Rydhmer L and Strandberg E (2011) Culling reasons in organic and conventional dairy herds and genotype by environment interaction for longevity. *Journal of Dairy Science* **94**, 1568–1575.  
 American Association for Public Opinion Research (AAPOR) (2015) <https://www.aapor.org/>.

American Grassfed Association (2018) American Grassfed Association grassfed dairy standards. <https://www.americangrassfed.org/aga-grassfed-dairy-standards/>.  
 Antaya NT, Soder KJ, Kraft J, Whitehouse NL, Guindon NE, Erickson PS, Conroy AB and Brito AF (2015) Incremental amounts of *Ascoplyllum nodosum* meal do not improve animal performance but do increase milk iodine output in early lactation dairy cows fed high-forage diets. *Journal of Dairy Science* **98**, 1991–2004.  
 Bouttes M, Darnhofer I and Martin G (2019) Converting to organic farming as a way to enhance adaptive capacity. *Organic Agriculture* **9**, 235–247.  
 Brito AF and Silva LHP (2020) Symposium review: comparisons of feed and milk nitrogen efficiency and carbon emissions in organic versus conventional dairy production systems. *Journal of Dairy Science* **103**, 5726–5739.  
 Brock CC and Barham BL (2013) ‘Milk is milk’: organic dairy adoption decisions and bounded rationality. *Sustainability* **5**, 5416–5441.  
 Coffey EL, Horan B, Evans RD and Berry DP (2016) Milk production and fertility performance of Holstein, Friesian, and Jersey purebred cows and their respective crosses in seasonal-calving commercial farms. *Journal of Dairy Science* **99**, 5681–5689.  
 Cross JA (2016) Dairying landscapes of the Amish in Wisconsin. *Material Culture* **48**, 16–31.  
 Denis-Robichaud J, Cerri RLA, Jones-Bitton A and LeBlanc SJ (2018) Performance of automated activity monitoring systems used in combination with timed artificial insemination compared to timed artificial insemination only in early lactation in dairy cows. *Journal of Dairy Science* **101**, 624–636.  
 Dillman DA, Smyth JD and Christian LM (2016) Internet, phone, mail and mixed-mode surveys: the tailored design method. *Reis* **154**, 161–176.  
 Flack S (2016) *The Art and Science of Grazing: How Grass Farmers Can Create Sustainable Systems for Healthy Animals and Farm Ecosystems*. White River Junction, VT: Chelsea Green Publishing.  
 Flaten O, Lien G, Ebbesvik M, Koelsing M and Valle PS (2006) Do the new organic producers differ from the ‘old guard’? Empirical results from Norwegian dairy farming. *Renewable Agriculture and Food Systems* **21**, 174–182.  
 Hanson J, Dismukes R, Chambers W, Greene C and Kremen A (2004) Risk and risk management in organic agriculture: views of organic farmers. *Renewable Agriculture and Food Systems* **19**, 218–227.  
 Hardie CA, Wattiaux M, Dutreuil M, Gildersleeve R, Keuler NS and Cabrera VE (2014) Feeding strategies on certified organic dairy farms in Wisconsin and their effect on milk production and income over feed costs. *Journal of Dairy Science* **97**, 4612–4623.  
 Hayden J, Rucker S, Phillips H, Heins B, Smith A and Delate K (2018) The importance of social support and communities of practice: farmer perceptions of the challenges and opportunities of integrated crop–livestock systems on organically managed farms in the northern US. *Sustainability* **10**, 1–26.  
 Kolver ES (2003) Nutritional limitations to increased production on pasture-based systems. *Proceedings of the Nutrition Society* **62**, 291–300.  
 Lapple D (2013) Comparing attitudes and characteristics of organic, former organic and conventional farmers: evidence from Ireland. *Renewable Agriculture and Food Systems* **28**, 329–337.  
 Lubell M, Niles M and Hoffman M (2014) Extension 3.0: managing agricultural knowledge systems in the network age. *Society & Natural Resources* **27**, 1089–1103.  
 McBride WD and Greene C (2009) Characteristics, costs, and issues for organic dairy farming, ERR-82. US Department of Agriculture, Economic Research Service.  
 Mullen KAE, Sparks LG, Lyman RL, Washburn SP and Anderson KL (2013) Comparisons of milk quality on North Carolina organic and conventional dairies. *Journal of Dairy Science* **96**, 6753–6762.  
 Organic Trust Plus Inc (2019) Program manual: certified grass-fed organic livestock. Available at [http://organicplustrust.com/assets/doc/OPT%20Certified%20Grass-Fed%20Organic%20Program%20Manual%20\(Posted\)%20\(3.1.19\).pdf](http://organicplustrust.com/assets/doc/OPT%20Certified%20Grass-Fed%20Organic%20Program%20Manual%20(Posted)%20(3.1.19).pdf).  
 Pereira ABD, Brito AF, Townson LL and Townson DH (2013) Assessing the research and education needs of the organic dairy industry in the north-eastern United States. *Journal of Dairy Science* **96**, 7340–7348.  
 Pirog RS (2004) Consumer perceptions of pasture-raised beef and dairy products: an internet consumer study.



- Rozzi P, Miglior F and Hand KJ** (2007) A total merit selection index for Ontario organic dairy farmers. *Journal of Dairy Science* **90**, 1584–1593.
- Soder KJ, Brito AF and Hoffman K** (2011) Effect of molasses supplementation and nutritive value on ruminal fermentation of a pasture-based diet. *The Professional Animal Scientist* **27**, 35–42.
- Sorge US, Moon R, Wolff LJ, Michels L, Schroth S, Kelton DF and Heins B** (2016) Management practices on organic and conventional dairy herds in Minnesota. *Journal of Dairy Science* **99**, 3183–3192.
- Stiglbauer KE, Cicconi-Hogan KM, Richert R, Schukken YH, Ruegg PL and Gamroth M** (2013) Assessment of herd management on organic and conventional dairy farms in the United States. *Journal of Dairy Science* **96**, 1290–1300.
- Su Y, Brown S and Cook ML** (2013) Stability in organic milk farm prices: a comparative study. Available at <https://ageconsearch.umn.edu/record/150735/>.
- USDA-AMS (US Department of Agriculture—Agricultural Marketing Service)** (2020) Organic dairy market news. Available at <https://www.ams.usda.gov/mnreports/dybdairyorganic.pdf>.
- USDA-NASS (US Department of Agriculture—National Agricultural Statistics Service)** (2017) 2017 Census of Agriculture Highlights: Farm Producers.
- USDA-NOP (US Department of Agriculture—National Organic Program)** (2020) Electronic Code of Federal Regulations. Available at [https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=3f34f4c22f9aa8e6d9864cc2683cea02&tpl=/ecfrbrowse/Title07/7cfr205\\_main\\_02.tpl](https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=3f34f4c22f9aa8e6d9864cc2683cea02&tpl=/ecfrbrowse/Title07/7cfr205_main_02.tpl).
- Van Vuuren AM and Van Den Pol A** (2006) Grazing systems and feed supplementation. Elgersma A, Dijkstra J and Tamminga S (eds), *Fresh Herbage for Dairy Cattle: The Key to a Sustainable Food Chain*. Heidelberg, Germany: Springer, pp. 85–101.
- Weber K, Heinze KL and DeSoucey M** (2008) Forage for thought: mobilizing codes in the movement for grass-fed meat and dairy products. *Administrative Science Quarterly* **53**, 529–567.
- Weiss L and Jeltsch F** (2015) The response of simulated grassland communities to the cessation of grazing. *Ecological Modelling* **303**, 1–11.
- Wilkinson JM, Lee MR, Rivero MJ and Chamberlain AT** (2020) Some challenges and opportunities for grazing dairy cows on temperate pastures. *Grass and Forage Science* **5**, 1–17.