Canadian Journal of Animal Science

Survey of feeding practices on dairy farms in Ontario and western Canada

Journal:	<i>Canadian Journal of Animal Science</i>
Manuscript ID	CJAS-2020-0077.R2
Manuscript Type:	Article
Date Submitted by the Author:	07-Dec-2020
Complete List of Authors:	Gee, Steven; University of Guelph, Department of Animal Biosciences Kelton, David; University of Guelph, Population Medicine Carpenter, Abigail; University of Guelph, Department of Animal Biosciences; CSA Animal Nutrition, LLC
Keywords:	management (nutritional), feeding, feedstuffs, Canada

SCHOLARONE™
Manuscripts

Survey of feeding practices on dairy farms in Ontario and western Canada

S. W. Gee¹, D. F. Kelton², and A. J. Carpenter^{1,3*}

¹Department of Animal Biosciences, University of Guelph, 120 Main St. E, Ridgetown, ON N0P2C0

²Ontario Veterinary College, University of Guelph, 50 Stone Rd. E, Guelph, ON N1G2W1

³Current affiliation: Department of Animal Science, Iowa State University, 1221 Kildee Hall, Ames, IA 50011

*Corresponding author: ajcarpen@iastate.edu

ABSTRACT

To establish a baseline understanding of feeding practices on Canadian dairies, a survey was distributed online to dairy producers. Responses were split into three categories as follows: western provinces (Alberta, British Columbia, Manitoba, and Saskatchewan; $n = 84$), Ontario freestall farms ($n = 75$), and Ontario tiestall farms ($n = 71$). Regional differences were observed for many feed ingredients; for example, corn and soybean meal were more commonly used in Ontario, while barley, wheat products, and grass hays were more commonly used in the western provinces ($P \leq 0.01$), consistent with local production of those crops. Producers ranked the most important factors in balancing rations in the following order: production (lactating cattle or heifers) or health (dry cows), cost, simplicity, and nutrient management; however, nutrient management was more important in the west for all types of diets ($P < 0.01$). Most farms frequently tested for ration dry matter and nutrient composition, although Ontario tiestall farms tested less often than other groups ($P = 0.09$). Overall, feeds aligned with common crops grown within region. Canadian farmers have a stated interest for improving production and health and place less emphasis on other factors such as cost, simplicity, and nutrient management.

Key words: management (nutritional), feeding, feedstuffs, Canada

INTRODUCTION

The dairy industry in Canada is an important part of the country's agricultural sector. The Canadian Dairy Information Centre (2017) reported that there are over 10 thousand dairy farms in Canada, shipping milk from approximately 945 thousand milking cows. While some descriptions of farm demographics of the Canadian dairy industry are commonly recorded—such as average herd size and the barn types—less is known regarding feeds and feeding practices

being used. There have been surveys of feeding practices in the United States (Mowrey and Spain, 1998), and Statistics Canada (2018) calculates the total production and land usage of field crops, but this does not cover how much of field crops are grown for feeding dairy cattle. These numbers cannot be used to assume the grains fed in each region on dairy farms, as these crops can be used for humans and other animal species. Documentation of common feeding practices would allow dairy researchers to establish a baseline understanding of nutritional management on dairy farms, providing a starting point for estimating the impact of proposed sustainable feeding practices, and would provide industry professionals such as nutritionists with a standard when making recommendations to producers.

Dairy Herd Improvement (DHI) services are widely used in Canada and cover a majority of dairy farms. In 2017, 74% of all Canadian dairy farms used DHI services in some capacity (67% in the four western provinces, 75% in Ontario, 79% in Quebec, and 59% in Atlantic Canada). Thus, survey distribution through DHI would be likely to reach most dairy producers in Canada (Valacta, 2018; Western Progress Report, 2018).

While the dairy industry has evolved tremendously in recent decades, along with our understanding of best practices, to our knowledge, no one to date has attempted to quantify the state of the industry's nutritional management and feeding practices through collection of producer survey data. To address this gap in knowledge, the objectives for data collected with this survey were to further understand the feeds and feeding practices dairy producers utilize in Canada and to examine producer strategies and attitudes towards feed management by region and facility type (e.g., freestall vs tiestall). Ultimately, these results will inform researchers and industry professionals as they identify objectives and strategies to promote a more profitable and sustainable dairy industry.

MATERIALS AND METHODS

Survey Distribution

An online survey was created using Qualtrics survey software (Qualtrics International, Inc., Seattle, WA, USA) for distribution by CanWest DHI (Guelph, ON, Canada). The survey was created at the University of Guelph, after approval from the Research Ethics Board (REB# 17-07-008). All producers on test with CanWest DHI received an electronic invitation to complete the survey from May to July 2018. Producers in Quebec received their survey invitation in French through Valacta (Sainte-Anne-de-Bellevue, QC, Canada). The survey was pretested by two dairy producers for feedback, after which the survey was translated into French and distributed to producers. All producers were able to select an English or French version of the survey.

Survey Content

Producers were first asked general information regarding their dairy operation, including their province, the size of their herd, whether their farm is organic, who is responsible for balancing their rations, and the type of milking operation they operated (i.e., parlor, tiestall, robot). The next section focused on the milking herd. Questions were posed to ascertain how the cattle were grouped, if the herd was given pasture access and/or topdress, the crude protein (CP) content of their lactating rations, if different rations were fed among the milking herd, and what management considerations were used when assigning cows to different rations if more than one lactation ration was used. Respondents were given a list of common feedstuffs with different forages, byproduct feeds, and grains, and asked to select the feeds included in their lactating cow diets. Respondents who selected “other” from this list were asked to report any feeds that were not included on the list. Similar questions were asked in the following sections, which focused

on dry cows and heifers. Producers indicated dry period length in the dry cow section. The final section was focused on nutrition management. Farmers were asked to rate factors such as simplicity, cost, performance, and health by priority when choosing rations for heifers, dry cows, and lactating cows. They were also asked how often feed was delivered and pushed up, how many sources they used for their feed, and how often they test their rations for dry matter and nutrient composition.

Survey responses

There were 230 completed surveys available for analysis (Table 1), or approximately 3% of milk recorded farms in Canada (Valacta, 2018), excluding Quebec and Atlantic Canada, which did not answer the survey in adequate numbers. Respondents represented 6% of farms in the remaining provinces (Ontario Progress Report, 2018; Western Progress Report, 2018). Ontario dairy producers represented 63% ($n = 146$) of responses, followed by Alberta at 15% ($n = 34$). The remaining responses came from British Columbia (10%, $n = 23$), Manitoba (7%, $n = 15$) and Saskatchewan (5%, $n = 12$). Response rate from each province varied from 6% of farms on DHI responding in Ontario to 13% of farms on DHI responding in Saskatchewan.

Data Analysis

Analysis was done on all survey responses using IBM SPSS Statistics 25 (Armonk, NY). Survey respondents were assigned to one of three categories based on location within Canada and facility type for farms located in Ontario. These categories were western provinces (WP; $n = 84$), which consisted of all responding farms located in Alberta, British Columbia, Manitoba, and Saskatchewan; Ontario tiestalls (OT; $n = 71$), which consisted of all responding farms in Ontario using a tiestall barn to house the milking herd; and Ontario freestalls (OF; $n = 75$), which

consisted of the remaining responding Ontario farms that did not use tiestall barns. WP farms included both freestall ($n = 75$) and tiestall ($n = 9$) facilities. These three categories were selected for analysis due to the balanced distribution between freestall and tiestall farms in Ontario, with both categories also being close to the number of responding farms in the four western provinces. A total of 9 French responses were received from herds in Quebec, but the sample size was not large enough for statistical analysis, and these responses are not included. Chi-squared tests were used to determine if there were significant differences in answers among the three categories in “yes” or “no” questions. Tukey’s test was used to determine significance of herd size between the three categories at $P \leq 0.05$. For the attitude rating questions, the Kruskal-Wallis test was used to determine significance among the three categories. Significance was declared at $P \leq 0.05$, and tendencies were noted at $0.05 < P \leq 0.10$.

RESULTS

Farm Demographics

General characteristics of farms that responded are reported in Table 1. The average herd size was 113 cows, which is larger than the national average (89 cows) but very close to the average herd size of DHI reporting farms in both Ontario and the western provinces (110 cows; Ontario Progress Report, 2018; Western Progress Report, 2018). Comparing the three groups, WP farms had the highest average herd size at 160 cows per herd, which was very close to the reported average herd size of 164 (Western Progress Report, 2018). OT farms had the lowest average herd size of 57 cows per herd, with OF in between the other two categories at 113 cows per herd. Eight (3.5%) of farms were organic, similar to the number of organic dairy farms in Canada (2%), and there were no differences among the categories ($P = 0.93$). Regarding facility type, 61% of farms surveyed were freestall and 35% were tiestall. In Ontario, 49% of the farms

were tiestall, with the majority (89%) of the tiestall farms in the survey located in Ontario. For the responding WP farms, 75 (88%) were freestall and 9 (11%) were tiestall. Ten farms indicated “other” for lactating cow housing, with 9 of these farms located in Ontario. As facility type was used as a main factor in designating the overall category, it was significantly affected by category ($P < 0.01$). Across responding farms, 17% used a robot to milk cows, with significant differences across the three groups ($P < 0.01$), as robots were used by 20% of WP farms and 31% of OF farms, while the OT farms had no robot farms.

Nutritional management

General feeding strategy questions showed some differences across the three categories (Table 2). The majority (83%) of respondents used nutritionists to balance their rations, compared to doing it themselves (14%) or having a veterinarian do it (4.2%). Across all farms, 37% of respondents indicated that they provide additional supplements to lactating cattle based on their age or stage of lactation (WP farms = 29%, OF farms = 35%, OT farms = 50%; $P = 0.06$). For lactating cattle, 25% of respondents indicated that they gave pasture access of any kind, with a significant effect of category, as pasture access was more common for OT farms (39% of respondents) compared to OF (17%) and WP farms (21%; $P = 0.01$). Average pasture access increased to 53% and 49% for dry cows and heifers, respectively. Again, access to pasture was greater in OT farms for dry cows (76% of respondents) versus OF (43%) and WP farms (41%; $P < 0.01$); the same was true for heifers, with 65% of OT respondents indicating pasture access compared to 40% of OF respondents and 44% of WP respondents ($P = 0.01$). The estimated number of months in an average year that lactating cows, heifers, and dry cows had pasture access is presented in Supplementary Table 1. Respondents were asked to select the CP content of their first and second lactation rations from a list of ranges (<12%, 12-14%, 15-17%,

18-20%, or >20%). For the first ration offered in lactation, the majority of respondents from all categories (59%) indicated that they fed 15-17% CP, followed by 18-20% (25%), with no effect of farm category ($P = 0.33$). In the second lactation ration, the majority of respondents (52%) again indicated feeding 15-17% CP, this time followed by 12-14% CP (14%). Again, there was no significant effect of farm category ($P = 0.63$).

Grouping strategies for lactating cows are outlined in Table 3. For lactating cows, respondents were asked how many groups animals were housed in and how many rations they were fed as separate questions. For decision factors for changing between groups and rations for lactating cattle, respondents could select multiple options from a list. Category significantly affected responses to both questions. OT respondents were more likely to indicate that they housed cows in one group (83%) compared to OF (57%) and WP farms (48%; $P < 0.01$), while OF respondents tended to be more likely to indicate that they only fed one ration to lactating cows (92%) compared to OT (77%) and WP farms (75%; $P = 0.07$). When asked to select from a list to indicate what decision factors were used to separate cattle between housing groups, the most commonly selected item was “stage of lactation,” selected by 58% of respondents who kept cattle in more than one group across all categories, followed by “age” at 44%. “Health” and “reproductive status” were selected by 21% and 18% of respondents with more than one group of lactating cattle, respectively, with 11% indicating “Other.” The only decision factor that was affected by farm category was “age,” with no one from OF farms indicating that this was a grouping decision factor, compared to 44% of WP respondents and 61% of OF respondents ($P < 0.01$). Regarding decision factors for changing between rations, farm category was not significant for any ($P \geq 0.11$). The most common selected decision factor for changing between rations was “milk production” (selected by 55% of respondents feeding more than one ration),

followed by “stage of lactation” (50%), and “nutritional requirements” (48%). Other factors included “reproductive status” (41%), “age” (19%), “health” (17%), and “other” (12%).

Grouping strategies for heifers and dry cows are reported in Table 4. Respondents were only asked to indicate how many rations were fed to their dry cows (including pre-fresh heifers) and how many rations were fed between weaning and first calving, without indicating housing groups. Farm category did not affect the number of rations fed to heifers between weaning and first calving ($P = 0.20$), with 38% of respondents indicating that they fed two rations, 31% indicating that they only fed one ration, and 24% of farms indicating that they fed three rations. The overwhelming majority of respondents across all categories indicated that pre-fresh heifers were fed the same ration as dry cows (90%; $P = 0.19$). When asked to select one or more options from a list for decision factors when switching between heifer rations, “age” was the most common at 85% of respondents who fed more than one ration between weaning and first calving (127 respondents; $P = 0.98$). Other reasons included “size” (57%), “reproductive status” (45%), “health” (13%), and “other” (9%). None of these reasons were different between farm categories ($P \geq 0.49$), with the exception of “reproductive status” ($P = 0.03$), which was most commonly selected for OF farms (58%) compared to WP (33%) and OT farms (44%). Most respondents indicated that they only fed one ration to dry cows, but it tended to be a more common practice for OT farms (72% of respondents) compared to OF (60%) and WP farms (55%; $P = 0.10$).

Responses to questions regarding feed bunk management are presented in Table 5. OT respondents reported that they delivered feed to lactating cows twice per day or more than twice per day (56% and 36%, respectively), while WP and OF farms were more likely to report delivering feed to lactating cows once per day (WP = 55%, OF = 42% of respondents; $P < 0.01$). When asked how often feed was pushed up throughout the day for lactating cows, the most

common response for WP and OT farms was two to four times per day (WP = 41%, OT = 50% of respondents), while only 22% of OF respondents indicated that they pushed up feed for lactating cows two to four times per day, and the most common response for OF farms was more than seven times per day (36% of respondents; $P = 0.03$). Nearly 80% of OT respondents indicated that they delivered feed to dry cows once or twice per day, and only 9% of OT respondents reported delivering feed to dry cows less than once daily. Conversely, 23% of WP respondents and 38% of OF respondents reported that they delivered feed to dry cows less than once per day, and 67% of WP respondents and 47% of OF respondents indicated that they delivered feed to dry cows once per day ($P < 0.01$). When asked how often feed was pushed up for dry cows throughout the day, 23% of WP respondents and 21% of OT respondents indicated “Never” compared to 8% of OF respondents, while the most commonly selected response for all three categories was “2-4 times per day” (WP = 38%, OF = 42%, OT = 52%; $P = 0.02$).

Respondents were asked questions regarding their management of feed ingredients (Table 6). The majority of respondents from all categories reported that they tested the dry matter content of wet feeds, but there was no difference between farm categories ($P = 0.27$). Similarly, when asked if they re-balanced rations after testing the dry matter content of wet feeds, the majority reported “Yes” or “Sometimes,” with no differences between categories ($P = 0.68$). While the majority of respondents indicated that they tested the nutrient contributions of any feeds in their rations, only 81% of OT farms responded “Yes” compared to 90% of WP farms and 93% of OF farms ($P = 0.09$). The majority of respondents indicated either “Yes” or “Sometimes” when asked if they re-balanced rations after testing nutrient contributions, with no differences between categories ($P = 0.15$). Information regarding which feeds were tested for dry matter or other nutrients and the frequency of testing is presented in Supplementary Table 2 and

3. Only one respondent indicated that they did not purchase any feeds, but there was variation between farm categories for the number of sources for purchased feeds ($P < 0.01$). Nearly half of OT respondents indicated that they only purchased feed from one source, while 83% of OT respondents indicated that they purchased feeds from one or two sources. For OF respondents, around a quarter of respondents indicated that they only purchased feed from one source, 68% reported that they purchased feed from one or two sources, and 90% of respondents indicated that they purchased feed from one, two, or three sources. For WP respondents, 27% indicated that they purchased feed from one source, 55% indicated that they purchased feed from one or two sources, and 77% indicated that they purchased feed from one, two, or three sources. Compared to OT and OF respondents with $<2\%$ from each category indicating that they purchased feed from five or more sources, 14% of WP respondents indicated that they purchased feed from five or more sources.

Feeds

Common forages fed to lactating cattle are presented in Table 7. The most common forage used in lactating cattle rations was conventional corn silage, used on 73% of farms. Farm category had a significant effect on corn silage use ($P < 0.01$), with corn silage being used more commonly in Ontario (OF, OT farms) compared to WP farms (WP farms = 56%, OF farms = 80%, OT farms = 84%; $P \leq 0.05$). Other commonly used forages include different varieties of haylage and hay. A significant effect was detected between farm categories in all grass, legume, and mixed hays ($P < 0.01$). OF farms were less likely to use grass hay within their rations compared to WP and OT farms ($P < 0.05$), use legume hay less than WP farms ($P < 0.05$), and use mixed hay less than OT farms ($P < 0.05$). Grass hay was most commonly used in WP farms ($P < 0.05$) compared to OT farms. There was a significant effect for farm category for usage of

legume ($P = 0.01$) and mixed ($P < 0.01$) haylages, with fewer WP farms using legume haylage than OF farms ($P < 0.05$) and mixed haylage ($P < 0.05$) compared to OF and OT farms. The overall category tended to affect grass haylage ($P = 0.08$), although mean differences between categories were all $P > 0.05$; 26% of WP respondents indicated that they fed grass haylage to lactating cows compared to 15% and 13% for OT and OF farms, respectively. Across Canada, 36% of respondents indicated using straw in lactating cow diets, with no differences between farm categories ($P = 0.52$).

Common concentrates and byproduct feeds fed to lactating cattle are presented in Table 8. These include corn grain (58%) and soybean meal (57%). Regionally, corn grain was used more on OT farms (73%; $P < 0.05$) than WP farms (50%). Soybean meal was more commonly used on OF farms (70%) than in WP (39%) and OT (56%) farms ($P < 0.05$). There were other significant effects found in concentrates across farms, especially in barley ($P < 0.01$), with WP farms most commonly reporting using it in lactation cow rations (69%), OF farms least commonly reporting it (4%), and OT farms intermediate (24%; $P < 0.05$). Another notable effect was seen in high moisture corn usage across categories ($P < 0.01$), with 4% of WP farms reporting use in lactating cow rations compared to 36% in OF farms and 32% in OT farms ($P < 0.05$). Regarding byproduct or coproduct feeds, the most commonly used were canola meal (35%) and corn distiller's grains (33%). Other byproducts included on the survey include beet pulp (8%), brewer's grain (10%), corn gluten meal (10%), soy hulls (4%), cottonseed (3%), and wheat distiller's grains (5%). Significant effects of farm category were observed for canola meal (35% across all categories; $P < 0.01$), with OT farms (15%) using it less than WP (49%) and OF farms (37%; $P < 0.05$). Significant effects were seen across categories for both beet pulp and wheat distiller's grain ($P < 0.01$), with both being used more often in WP farms ($P < 0.05$) than

in OF and OT farms. Overall, significant regional effects were found for most of the surveyed feeds across all categories, except for straw, corn distiller's grains, corn gluten meal, cottonseed, and soy hulls.

Dry cow rations showed some significant regional differences. Forages fed to dry cows are presented in Table 9. Conventional corn silage was again the most common forage fed across Ontario and western Canada at 66% of dry rations but was used less in WP farms (42%) compared to OF farms (81%) and OT farms (77%; $P < 0.05$). Grass hay was fed significantly more often in WP farms (72%) than in Ontario (OF farms = 26%; OT farms = 40%; $P < 0.05$), while mixed hay was fed more on OT farms (51%) versus WP (24%) and OF farms (21%; $P < 0.05$). Grass haylage was more common in WP farms (26%) than OF farms (8%; $P < 0.05$), while mixed haylage was fed less in WP farms (9%) than OF (31%) and OT farms (26%; $P < 0.05$). Straw was fed significantly less in OT farms (23%) than WP (50%) and OF farms (67%; $P < 0.05$). There were also regional differences for use of concentrates (Table 10). Barley was fed more in WP farms (45%) versus all Ontario farms (OF farms = 0%, OT farms = 15%), and OF farms were significantly lower than both WP and OT ($P < 0.05$). Soybean meal was fed significantly less on WP farms (17%) than OF farms (43%; $P < 0.05$). Corn grain was fed significantly more often in OT dry rations (29%) than on WP farms (9%; $P < 0.05$). The most common byproduct feeds in dry cow rations were canola meal (20%) and corn distiller's grains (18%). Significant regional differences in byproduct feeds were uncommon, with the exceptions of canola meal, which was used less frequently in OT farms (9%) compared to OF (26%) and WP farms (22%; $P < 0.05$), and wheat distiller's grains, which was used on WP farms (9%) but not OF or OT farms ($P < 0.05$).

Forages used in heifer rations are presented in Table 11, and concentrate and byproduct feeds are presented in Table 12. Conventional corn silage was again the most common forage fed in OF and OT farms (both 68%), being fed significantly less in WP farms (37%; $P < 0.05$). Grass hay was most commonly fed in WP farms (61%) versus both OT (23%) and OF farms (32%; $P < 0.05$). Mixed hay was fed more frequently on OT farms (68%) compared to WP farms (40%; $P < 0.05$). Mixed haylage was fed more in Ontario (OF farms = 53%, OT farms = 36%) compared to WP farms (17%; $P < 0.05$), while straw was again used less in OT farms (10%) than WP (40%) and OF farms (36%; $P < 0.05$). Barley was the most frequently fed concentrate in WP farms (62%), significantly greater than in Ontario (OF farms = 10%, OT farms = 21%; $P < 0.05$). Soybean meal was fed more in OF (46%) and OT farms (39%) compared to WP farms (16%; $P < 0.05$), and corn grain was fed significantly more in OT farms (57%) compared to WP (22%) and OF farms (33%; $P < 0.05$). Byproduct feeds were less commonly fed in heifer diets, with fewer significant differences between categories.

Respondents were asked to report feeds that they used that were not listed in the survey responses. These feeds are presented in Supplementary Tables 4-6.

Attitudes

Producer attitudes toward five factors influencing their feed management choices (listed as performance, cost, simplicity, nutrient management, and health) followed a clear pattern across regions (Table 13). Respondents were asked to rank each of the listed factors, where one is the most important and five is the least important; therefore, when averages are reported here, lower numbers indicate more importance for respondents. For lactating diets, the most important factor was performance (average = 1.5), followed by health (average = 2.1), cost (average = 3.5) and simplicity (average = 3.8), and then nutrient management last (average = 4.2). There were

some significant differences among categories, as WP farms ranked nutrient management higher than OT and OF farms (3.7 vs. 4.5 and 4.3 for WP, OF, and OT, respectively; overall $P < 0.01$). Cost was ranked lowest for WP respondents (3.7) and highest for OF respondents (3.2), with OT intermediate (3.5; overall $P = 0.02$). For dry cow diets, the most important factor was health (average = 1.8), followed by performance (average = 1.9), simplicity (average = 3.5), cost (average = 3.6) and then nutrient management last (average = 4.2). Again, WP farms ranked nutrient management higher (3.6) compared to OF (4.6) and OT respondents (4.3; overall $P < 0.01$). Cost was also again ranked lowest for WP respondents (3.8) and highest for OF (3.5), with OT intermediate (3.6; overall $P = 0.04$). Respondents in Ontario ranked performance higher for dry cow diets (1.7 for OT and OF) compared to WP (2.1; overall $P = 0.01$). Nationally for heifer diets, the most important factor was performance (average = 1.7), followed by health (average = 2.3), simplicity (average = 3.3), cost (average = 3.6), and nutrient management last (average = 4.1). Once again, WP respondents ranked nutrient management higher than Ontario farms (WP = 3.7 vs. 4.5 and 4.3 for OF and OT, respectively; overall $P < 0.01$). Cost followed a similar numerical pattern in rankings for heifers as it did for lactating and dry cows, with OF ranking cost at 3.5, OT ranking cost at 3.6, and WP ranking cost at 3.8 (overall $P = 0.08$), but the difference between categories was $P > 0.05$. Performance was ranked highest by OF farms (1.5) and lowest for WP farms (1.9), with OT intermediate (1.7; overall $P = 0.03$).

Respondents were asked to choose on a scale from “strongly agree” to “strongly disagree” their agreement with the following statements: “I am willing to incorporate new feeds into rations,” “Feedstuffs should be tested frequently,” and “Rations should be rebalanced often” (Table 14). Across all farm categories, 82% of respondents on average strongly to somewhat agreed that they were willing to incorporate new feeds into rations ($P = 0.96$), and 86% of

respondents on average strongly to somewhat agreed that rations should be rebalanced often ($P = 0.30$). While the overwhelming majority of respondents (91%) strongly to somewhat agreed that feedstuffs should be tested frequently, there was a significant effect of farm category, with 84% of OT respondents agreeing, 90% of OF respondents agreeing, and 97% of WP respondents agreeing with the statement ($P = 0.02$).

DISCUSSION

Comparison of Responses to Actual Herd Demographics

Comparing the survey demographics responses to nationwide numbers from the Canadian Dairy Information Centre and provincial numbers from the DHI Progress Reports showed similarities (Ontario Progress Report, 2018; Western Progress Report, 2018), indicating that these producer responses were likely an adequate representation of farms across Canada and are therefore useful for drawing general conclusions on nutritional management practices across the country. It is unknown why there was such a poor response from the eastern farmers, especially Quebec, due to the large number of producers from the province. Potentially, Quebec producers could have been more receptive to a survey from Quebec rather than Ontario. The five provinces included in this study contained 3,607 dairy farms using DHI as of 2017; based on these farm numbers, the survey had a 6% response rate in those provinces combined. Herd size numbers reported here are similar to DHI values (Table 1). DHI reports a combined average of 110 cows in Ontario and the western provinces, with an average herd size of 164 cows for the four western provinces and 91 cows for Ontario, while our survey responses reported an average of 160 cows for the four western provinces and 87 cows for Ontario. The number of organic farms also followed national numbers closely (Table 1), as national numbers show 2% of dairy farms are organic, compared to 3% of responding farms being organic based on our survey responses

(Statistics Canada and Canadian Dairy Commission, 2018). For facility type (Table 1), Ontario had proportionally fewer tiestall responses compared to the number of tiestalls in the province, as tiestall farms were at 49% of Ontario respondents compared to 69% provincially based on DHI numbers. Conversely, a greater percentage of robotic farms responded compared to provincial averages, with 19% of currently surveyed Ontario farms being robotic compared to 11% provincially based on DHI numbers. Since nearly all robotic farms are also freestall farms, this increase in robotic numbers follows the greater percentage of answering freestall farms. In the 4 western provinces, 88% of farms are freestall, and 21% are robotic herds based on DHI numbers, which matches up very closely to the survey farm numbers (88% freestall farms, 20% robotic herds).

Overall, the demographics of the respondents fairly represent the population demographics in Ontario and western Canada. It is disappointing there was an inadequate amount of responses in Quebec and eastern Canada for analysis. This is possibly due to the survey being done from a different region instead of from Quebec. The timeline for when the survey went out may have also depressed the number of responses, as spring is generally a busy time on farms if producers are working on spring seeding. This could have potentially been more of an issue out east, where generally farms are smaller (Statistics Canada and Canadian Dairy Commission, 2018).

Feeding and Group Management Differences

There were differences between freestall and tiestall farms within the province of Ontario based on survey responses, indicating that facility type is associated with differences in nutritional management practices. For example, tiestall farms generally feed their cows more often than freestall farms, although freestall farms push up feed more (Table 5). The greater

usage of pasture on tiestall farms could be due to farmers on tiestall farms letting their cows out for exercise and considering this as “being on pasture” (Table 2).

Questions regarding grouping strategies can show how cows are organized in a lactating herd and may provide an indication of whether producers are feeding lactating cattle based on different nutritional requirements throughout lactation. Stage of lactation and age were the two main reasons for grouping lactating cattle (Table 3). Since cattle have different nutritional requirements at different stages of lactation, grouping strategies are often related to the number of rations fed to lactating cattle. Tiestall farms generally do not group cows as they have their own individual stalls, and in the current data, significantly more tiestall farms have only one group than freestall farms (Table 3). OF farms fed fewer diets than the WP farms, which were also mostly freestall farms. However, the difference between freestall and tiestall farms in Ontario was not significant, with 92% of freestall farms using one ration compared to 77% of tiestall farms. This difference between regions may be linked with the previous question about grouping, as WP farms had more groups than Ontario farms (OT, OF). Another explanation could be the fact that WP farms had significantly increased herd sizes compared to both Ontario categories (Table 1), which could lead to an increase in the number of rations fed as more feed is needed on these farms. While feeding and grouping strategies are shown to be different between freestall and tiestall farms, there is little difference in rations fed, showing more regional differences there, and likely reflecting regional differences in crop production (Tables 7-12).

Feeding Strategies

Ration changes through lactation were most commonly responses to nutritional requirements, reproductive status, milk production, and days in milk (Table 3). There were no differences due to barn type or region, showing these were universally the most common reasons

for changing to a different ration. These factors are largely interconnected throughout lactation, and producers were allowed to select more than one answer. Based on survey responses, the feeding of multiple rations in lactating cattle herds is still uncommon, with only around one-fifth of respondents using two or more rations. Feeding multiple rations was a more common strategy in dry cattle (Table 4); however, the majority of farms fed one ration during the dry period. This is likely due to producers feeding the traditional “far off” and “close up” or “steam up” rations, although it could be that some farms are feeding dry cows and pre-fresh heifers as two separate groups. For rations between weaning and first calving (Table 4), the most common response was two rations, followed by one and three. Diets were changed most commonly due to heifer differences in age, size and reproductive status. Freshly weaned calves have very different requirements compared to older heifers, so it is puzzling that 30% of all respondents only fed one ration between weaning and first calving. A possible reason for this may be the fact that the rations excluded any diets that included pasture access, which may lead to some diets being left unmentioned on the responses.

Ration Ingredients

Differences in ration ingredients generally follow national numbers for crops grown in those regions (Tables 7-12). Barley and wheat are grown in much greater quantities in the west. While 4.9 million acres of barley were grown in the four western provinces in 2017, 75 thousand acres were grown in Ontario, reflecting the large gap in barley usage in dairy rations (Statistics Canada Table 32-10-0359-01, 2018). Likewise, significant regional differences in use of corn concentrates, silages, and soybean products are due to corn and soybeans being more common crops in Ontario than the west. In 2017, 2.06 million acres of corn and 3.13 million acres of soybeans were grown in Ontario, compared to 435 thousand acres of corn and 313 thousand

acres of soybeans grown in all four western provinces combined (Statistics Canada Table 32-10-0359-01, 2018). These numbers show that usage of grains and concentrates follow regional growth trends.

Grass hays and haylages were or tended to be more common in the four western provinces while mixed hays and haylages were more common in Ontario. Statistics in the survey show there are more grass hays fed in the four western provinces than Ontario. However, the national data showed that alfalfa was more commonly grown in the western provinces than Ontario, which is not seen in the data (Statistics Canada Table 32-10-0416-01, 2018). Statistics Canada stated that 17,214 farms reported growing alfalfa in 2016, compared to 37,145 farms in the four western provinces. This may be due to the farmer misinterpreting alfalfa as not being a legume, which was seen in the “other” section for some responses. Another explanation is the majority of the western province farms growing alfalfa were not dairy farms but potentially beef or another type of farm.

Corn distiller's grains were the most common byproduct feed. Regional differences were found for use of a few byproducts, with beet pulp, bypass fats, canola meal, and wheat distiller's grains being more common in the western provinces. Again, this is likely due to where feeds are being grown as beets, canola, and wheat are more commonly grown in the four western provinces versus Ontario. In Ontario during 2017, canola was grown on 43 thousand acres, while wheat was grown on 1.01 million acres, with no numbers reported for sugar beets. This is dwarfed by the four western provinces in 2017, in which canola was grown on 22.835 million acres, wheat was grown on 20.912 million acres, and sugar beets were grown on 26 thousand acres (Statistics Canada Table 32-10-0359-01, 2018). However, this does not explain the difference in bypass fats, as well as differences between OF and OT farms over using canola

meal in lactating rations. More differences in ingredients used between categories were found in lactating diets compared to both dry and heifer diets, consistent with the fact that lactating rations tend to contain more feed ingredients compared to dry and heifer rations.

Comparing the US regions to their neighboring Canadian counterparts (WP to northwestern states, Ontario to Northeast and Midwest states; Mowrey and Spain, 1998), the most common feeds are the same in both studies, with corn and soybean products more common in Ontario and barley and wheat products more common in the west. However, there are some major differences when comparing regions, with grass hay being more prevalent out West compared to Ontario having more alfalfa, where the opposite was found in the American counterparts. The American counterparts also used greater amounts of grains and byproducts such as corn grain and soybean meal. Whether this is still true 20 years after the survey by Mowrey and Spain (1998) is unknown.

Attitudes

Of the five areas to rank while balancing rations, performance was generally rated the highest for lactating and heifer rations (Table 13). In dry cow rations, performance was ranked second to health. Overall, farmers were more interested in cow performance above all other factors. In Canada, dairy farms operate using a supply management system. The Canadian supply management system controls the Canadian dairy industry by fixing the price producers are paid for their milk, using a quota system to control production per farm, and by controlling the amount of imports from other countries (Dairy Farmers of Canada, 2019). For Canadian dairy farmers, producing enough milk to meet their quota will maximize their income from their dairy cattle, and this focus on production appears to be true for most responding farms. However, since farmers cannot produce over quota in the supply management system, this interest in increasing

production seems to be counter-intuitive, unless that farmer was shipping under quota. Even within the quota system, maximizing milk per cow often improves the efficiency of a herd as opposed to milking a greater number of cows to fill the same level of quota. Improving production efficiency is likely the top goal for Canadian dairy producers and this is reaffirmed with the survey. For dry and heifer rations, respondents may have taken “performance” to mean something different than milk production. For dry cattle, respondents could have interpreted it as either production in the next lactation or maintaining target body condition through the dry period. Both of these factors would be considered important and could explain why production was very important in dry cattle rations. For heifers, “performance” was likely taken to mean growth performance. The fact that “performance” can be interpreted in different ways could have led to its increased importance among respondents.

Health was rated the second highest factor across lactating cows and heifers, and first for dry cow rations. Health ranks high as farmers want to minimize sickness on their farms, as healthier cows will produce more milk and have more reproductive success while minimizing treatment and veterinary costs. Following health was cost and simplicity, which were generally valued similarly, with cost slightly more important in lactating cow rations and simplicity ranking higher for dry cow and heifer rations. Nutrient management was rated the lowest priority, although it was ranked higher for western provinces compared to Ontario.

The relatively low importance of ration costs is interesting, as feed costs are a high expense for dairy farmers. Feed costs are the number one expense for Canadian dairy farms, encompassing 27% of all costs in 2010 (Lachapelle et al., 2014). Thus, it may be expected that farmers may place high priority on reducing feed costs. Survey respondents seem to focus more on improving the production of their cattle to lower costs instead of focusing on cheaper feeds,

as suggested by their valuing cow performance and health over feed costs. Yet when comparing to the feeds they use in their rations, the survey found farmers generally use feeds more commonly grown within their region, so cost is likely still taken into consideration and may be underrated by respondents. Simplicity is similarly rated to cost and ranks higher in dry and heifer diets compared to lactating cow rations. This matches with the ration ingredient responses, which showed that producers use less feed ingredients for those rations compared to lactating cow rations. The low ranking of nutrient management demonstrates that for respondents, productivity takes priority over all else, even if cheaper and more efficient feeding strategies are available. This is an area of opportunity for producer education, particularly for farms in Ontario bordering the Great Lakes. Nutrient management had a higher rating in WP farms, having a higher average rating than cost in dry and heifer diets and a higher average rating than simplicity for lactating and dry diets there. The survey found that nutrient management is less important on OF and OT farms. There was a significant difference in WP farms as well, as production had a lower average rating for heifer and dry cow diets, while cost had a lower average rating in all three types of rations compared to OF and OT farms. It seems that these are the areas that were more often ranked lower for an increase in rank for nutrient management. However, even with this increase, nutrient management still had the lowest average rating among WP farms. The vast majority of respondents used nutritionists, who may have different views than the producers themselves.

There are inconsistencies comparing these results with results for grouping and ration strategies. Since there are lower levels of precision feeding, there may be expectations for simplicity and cost to rate higher, especially in regard to the dry and heifer rations. There may be some bias shown in this question as farmers, even though answering anonymously, want to appear to be doing the best for their cattle regardless of cost.

Feed Management

Questions were asked to determine if farmers were willing to incorporate new feeds along with their attitudes for testing feeds and rebalancing rations (Table 14). St-Pierre and Weiss (2015) showed that nutrient composition within feeds can vary even within samples on farms. These questions were examining whether farmers were managing these potential variations. In survey answers, most farms agreed with frequent testing and rebalancing. However, even though they tested significantly less, the majority of OT farms agreed with this statement.

Overall, survey responses provide an adequately representative overview of current feed and nutrition management practices on dairy farms in Canada. Canadian dairy producers responding to the survey generally follow national numbers for herd size and barn type, and feeding practices seem to follow the types of crops grown within that particular region. Farmers value production and health as the most important factors in creating a dairy ration for all stages of cattle. It is possible that the Canadian quota system leads to producers focusing more on improving the efficiency of their production to lower costs rather than using cheaper feeds. Numbers do show that although cost is not valued as much by producers, there is still a large impact as farmers will get their feed locally. These results can inform dairy researchers and industry professionals as they identify objectives for sustainable progress in the Canadian dairy industry.

ACKNOWLEDGEMENTS

The authors are grateful for the contributions of the producers who responded to the survey and Richard Cantin from CanWest DHI for assisting with survey distribution. This

research was funded in part by a Discovery Grant from the Natural Sciences and Engineering Research Council of Canada.

For Review Only

REFERENCES

- Canadian Dairy Information Centre. 2017. Number of farms, dairy cows and dairy heifers. [Online] Available: <https://www.dairyinfo.gc.ca/eng/dairy-statistics-and-market-information/farm-statistics/farms-dairy-cows-and-dairy-heifers/?id=1502467423238> [2019 Apr. 9]
- Dairy Farmers of Canada. 2019. What is Supply Management? [Online] Available: <https://www.mycanadianmilk.ca/what-is-supply-management> [2019 Apr. 9]
- Lachapelle, J. 2014. Canadian Agriculture at a Glance Overview of livestock farm operating expenses. Statistics Canada. Catalogue no. 96-325-X. [Online] Available: <https://www150.statcan.gc.ca/n1/en/pub/96-325-x/2014001/article/14084-eng.pdf?st=PZ9z-oYD> [2018 Aug. 16]
- Mowrey, A., and J.N. Spain. 1999. Results of a nationwide survey to determine feedstuffs fed to lactating dairy cows.. J. Dairy Sci. **82**:445–51.
- CanWest DHI. 2018. 2017 Ontario Progress Report. [Online] Available: <http://www.canwestdhi.com/flipon17/index.html#p=2>. [2019 Mar. 19]
- St-Pierre, N.R., and W.P. Weiss. 2015. Partitioning variation in nutrient composition data of common feeds and mixed diets on commercial dairy farms. J. Dairy Sci. **98**:5004-15.
- Statistics Canada and Canadian Dairy Commission. 2018. 2017 Edition - Statistics of the Canadian Dairy Industry. [Online] Available: http://www.dairyinfo.gc.ca/index_e.php?s1=dff-fcil#farm. [2018 Aug. 16]
- Statistics Canada. 2018. Table 32-10-0359-01, Estimated areas, yield, production, average farm price and total farm value of principal field crops, in metric and imperial units. [Online]

Available: <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3210035901>. [2018 Aug. 16]

Statistics Canada. 2018. Table 32-10-0416-01, Hay and field crops. [Online] Available:

<https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3210041601> [2018 Aug. 16]

Valacta. 2018. The Evolution of Valacta Atlantic Dairy Production 2017 Stats. [Online]

Available: <https://www.valacta.com/en-ca/library/2017-evolution-valacta-atlantic-dairy-production-part-1> [2019 Mar. 19]

CanWest DHI. 2018. 2017 Western Progress Report. [Online] Available:

<http://www.canwestdhi.com/flipwest17/index.html>, [2019 Mar. 19]

Table 1: Farm characteristics of survey respondents.

	Pan-Canadian Farm Location ¹								<i>P</i> -value ²
	All respondents		WP		OF		OT		
Herd size (number of cows)									< 0.01
Average	113		160 ^a		115 ^b		57 ^c		
Minimum	12		12		32		25		
Maximum	1100		1100		480		250		
Standard deviation	127		180		87		30		
Survey questions and responses ³	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Is your farm organic?									0.93
Yes	8	3.5	3	3.6	3	4.0	2	2.8	
No	222	96.5	81	96.4	72	96.0	69	97.2	
In what type of barn do you house your lactating cows?									< 0.01
Freestall	140	60.9	74	88.1 ^a	66	88.0 ^a	0	0.0 ^b	
Tiestall	80	34.8	9	10.7 ^a	0	0.0 ^b	71	100.0 ^c	
Other	10	4.4	1	1.2	9	12.0	0	0.0	
Do you utilize a robot for milking cattle?									< 0.01
Yes	40	17.4	17	20.2 ^a	23	30.7 ^a	0	0.0 ^b	
No	189	82.2	67	79.8 ^a	51	68.0 ^a	71	100.0 ^b	
No response	1	0.4	0	0.0	1	1.3	0	0.0	

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Overall effect of pan-Canadian farm location (WP, OF, and OT)

³ Percentages indicate % of total respondents in pan-Canadian farm location who chose the response.

^{a,b,c} Numbers with different superscripts within a row differ significantly ($P < 0.05$).

Table 2: Survey responses regarding general ration management

Survey questions and responses ²	Pan-Canadian Farm Location ¹								<i>P</i> -value ³
	All respondents		WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Who is responsible for balancing your rations?									0.08
Nutritionist	188	82.8	68	82.9	59	79.7	61	85.9	
Producer	30	13.2	14	17.1	9	12.2	7	9.9	
Veterinarian	9	4.0	0	0.0 ^a	6	8.1 ^b	3	4.2 ^{ab}	
Do you provide additional supplements to lactating cattle based on age or stage of lactation?									0.06
Yes	68	37.4	18	29.0	24	35.3	26	50.0	
No	114	62.6	44	71.0	44	64.7	26	50.0	
Do you give cattle access to pasture at any point during the year?									
Yes (lactating cows)	57	25.1	17	20.5 ^a	13	17.3 ^a	27	39.1 ^b	0.01
Yes (heifers)	106	49.1	34	43.6 ^a	29	40.3 ^a	43	65.2 ^b	0.01
Yes (dry cows)	117	52.7	33	41.3 ^a	31	43.1 ^a	53	75.7 ^b	< 0.01
What is the CP content of your first lactating ration with no pasture access?									0.33
< 12% CP	1	0.5	1	1.5	0	0.0	0	0.0	
12-14% CP	25	13.0	6	9.1	10	14.9	9	15.0	
15-17% CP	113	58.6	34	51.5	43	64.2	36	60.0	
18-20% CP	48	24.9	21	31.8	14	20.9	13	21.7	
> 20% CP	6	3.1	4	6.1	0	0.0	2	3.3	
What is the CP content of your second lactating ration with no pasture access?									0.63
12-14% CP	4	11.8	2	14.3	1	20.0	1	6.7	
15-17% CP	19	55.9	6	42.9	2	40.0	11	73.3	
18-20% CP	11	32.3	6	42.9	2	40.0	3	20.0	

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

^{a,b,c} Numbers with different superscripts within a row differ significantly ($P < 0.05$).

For Review Only

Table 3: Survey responses regarding grouping strategies for lactating cattle

Survey questions and responses ²	Pan-Canadian Farm Location ¹								<i>P</i> -value ³
	All respondents		WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
How many groups do you keep your cattle in?									< 0.01
1	139	61.2	40	47.6 ^a	42	56.8 ^a	57	82.6 ^b	
2	44	19.4	21	25.0	14	18.9	9	13.0	
3	28	12.3	14	16.7 ^a	12	16.2 ^a	2	2.9 ^b	
4+	16	7.1	9	10.7	6	8.1	1	1.5	
Please specify how you separate cattle between groups. ⁴									
Age	39	44.3	19	44.2 ^a	20	60.6 ^a	0	0.0 ^b	< 0.01
Health	18	20.5	10	23.3	7	21.2	1	8.3	0.52
Reproductive status	16	18.2	6	14.0	6	18.2	4	33.3	0.31
Stage of lactation	51	58.0	22	51.2	20	60.6	9	75.0	0.46
Other	10	11.4	4	9.3	5	15.2	1	8.3	
How many rations do you feed your cattle?									0.07
1	183	81.3	62	74.7	69	92.0	52	76.5	
2	30	13.3	15	18.1	6	8.0	10	14.7	
3	8	3.6	5	6.0	0	0.0	3	4.4	
4+	4	1.8	1	1.2	0	0.0	3	4.4	
What are your reasons for changing between rations? ⁴									
Age	8	19.1	4	20.0	2	33.3	2	12.5	0.54
Nutritional requirements	20	47.6	8	40.0	2	33.3	10	62.5	0.51
Stage of lactation	21	50.0	9	45.0	3	50.0	9	56.3	0.8
Milk production	23	54.8	8	40.0	3	50.0	12	75.0	0.11
Reproductive status	17	40.5	7	35.0	3	50.0	7	43.8	0.62
Health	7	16.7	3	15.0	1	16.7	3	18.8	0.96
Other	5	11.9	1	5.0	1	16.7	3	18.8	

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

⁴ Respondents could select multiple choices.

^{a,b,c} Numbers with different superscripts within a row differ significantly ($P < 0.05$).

For Review Only

Table 4: Survey responses regarding dry cow and heifer ration management

Survey questions and responses ²	Pan-Canadian Farm Location ¹								<i>P</i> -value ³
	All respondents		WP		OF		OT		
			<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
How many rations do you feed dry cows and pre-fresh heifers?									0.10
1	132	61.7	43	55.1	43	59.7	46	71.9	
2	79	36.9	34	43.6	28	38.9	17	26.6	
3+	3	1.4	1	1.3	1	1.4	1	1.6	
Do pre-fresh heifers get the same ration as dry cows?									0.19
Yes	195	90.7	75	94.9	64	90.1	56	86.2	
No	20	9.3	4	5.1	7	9.9	9	13.9	
How many rations do you feed between weaning and first calving?									0.20
1	65	30.4	20	25.6 ^{ab}	17	23.6 ^a	28	43.8 ^b	
2	81	37.9	31	39.7	30	41.7	20	31.3	
3	52	24.3	22	28.2	18	25.0	12	18.8	
4+	16	7.5	5	6.4	7	9.7	4	6.3	
What are your reasons for changing between heifer rations? ⁴									
Age	127	85.2	49	84.5	47	85.5	31	86.1	0.98
Size	85	57.1	35	60.3	31	56.4	19	52.8	0.77
Reproductive status	67	45.0	19	32.8 ^a	32	58.2 ^b	16	44.4 ^{ab}	0.03
Health	20	13.4	9	15.5	5	9.1	6	16.7	0.49
Other	13	8.7	4	6.9	6	10.9	3	8.3	

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

⁴ Respondents could select multiple choices.

^{a,b,c} Numbers with different superscripts within a row differ significantly ($P < 0.05$).

For Review Only

Table 5: Survey responses regarding feed bunk management

Survey questions and responses ²	Pan-Canadian Farm Location ¹								<i>P</i> -value ³
	All respondents		WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
How often do you deliver feed to lactating cows?									<0.01
Less than once per day	2	0.0	0	0.0	1	1.4	1	1.5	
Once per day	77	35.6	43	55.1 ^a	30	41.7 ^a	4	6.1 ^b	
Twice per day	93	43.1	24	30.8 ^a	32	44.4 ^{ab}	37	56.1 ^b	
More than twice per day	44	20.4	11	14.1 ^a	9	12.5 ^a	24	36.4 ^b	
How often do you push up feed for lactating cows?									0.03
Never	13	6.0	3	3.8	7	9.7	3	4.5	
Once per day	5	2.3	2	2.6	1	1.4	2	3.0	
2-4 times per day	81	37.5	32	41.0 ^a	16	22.2 ^b	33	50.0 ^a	
5-7 times per day	63	29.2	22	28.2	22	30.6	19	28.8	
> 7 times per day	54	25.0	19	24.4 ^{ab}	26	36.1 ^a	9	13.6 ^b	
How often do you deliver feed to dry cows?									<0.01
Less than once per day	51	23.6	18	23.1 ^{ab}	27	37.5 ^a	6	9.1 ^b	
Once per day	112	51.9	52	66.7 ^a	34	47.2 ^b	26	39.4 ^b	
Twice per day	44	20.4	8	10.3 ^a	10	13.9 ^a	26	39.4 ^b	
More than twice per day	9	4.2	0	0.0	1	1.4	8	12.1	
How often do you push up feed for dry cows?									0.02
Never	38	17.6	18	23.1 ^a	6	8.3 ^b	14	21.2 ^{ab}	
Once per day	29	13.4	11	14.1	8	11.1	10	15.2	
2-4 times per day	94	43.5	30	38.5	30	41.7	34	51.5	
5-7 times per day	26	12.0	9	11.5	12	16.7	5	7.6	
> 7 times per day	29	13.4	10	12.8 ^{ab}	16	22.2 ^a	3	4.5 ^b	

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

^{a,b,c} Numbers with different superscripts within a row differ significantly ($P < 0.05$).

For Review Only

Table 6: Survey responses regarding ingredient management

Survey questions and responses	Pan-Canadian Farm Location ¹								P-value
	All respondents		WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
How many sources do you purchase feed from?									<0.01
0	1	0.5	0	0.0	1	1.4	0	0.0	
1	69	31.9	21	26.9 ^a	14	23.6 ^a	31	47.0 ^b	
2	78	36.1	22	28.2	32	44.4	24	36.4	
3	42	19.4	17	21.8	16	22.2	9	13.6	
4	13	6.0	7	9.0	5	6.9	1	1.5	
5+	13	6.0	11	14.1 ^a	1	1.4 ^b	1	1.5 ^b	
Do you test the dry matter of wet feeds in your rations?									0.27
Yes	198	93.0	74	96.1	67	93.1	57	89.1	
No	15	7.0	3	3.9	5	6.9	7	11.0	
Do you rebalance your rations after testing the feed for dry matter?									0.68
Yes	122	62.2	41	56.2	46	68.7	35	62.5	
Sometimes	60	30.6	26	35.6	17	25.4	17	30.4	
No	14	7.1	6	8.2	4	6.0	4	7.1	
Do you test the nutrient composition of any feeds in your rations?									0.09
Yes	186	88.2	68	89.5	67	93.1	51	81.0	
No	25	11.9	8	10.5	5	6.9	12	19.0	
Do you rebalance your rations after testing nutrient composition?									0.15
Yes	148	81.8	52	77.6	58	89.2	38	77.6	
Sometimes	28	15.5	11	16.4	7	10.8	10	20.4	
No	5	2.8	4	6.0	0	0.0	1	2.1	

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

^{a,b,c} Numbers with different superscripts within a row differ significantly ($P < 0.05$).

For Review Only

Table 7: Frequency of use of selected forages in lactating rations reported by survey respondents

Select forages ²	Pan-Canadian Farm Location ¹								<i>P</i> -value ³
	All respondents		WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Corn silage, BMR	34	15.4	5	6.3 ^a	18	24.0 ^b	11	16.7 ^{ab}	0.01
Corn silage, conventional	161	72.9	45	56.3 ^a	60	80.0 ^b	56	84.9 ^b	<0.01
Hay, grass	60	27.2	36	45.0 ^a	7	9.3 ^b	17	25.8 ^c	<0.01
Hay, legume	65	29.4	32	40.0 ^a	12	16.0 ^b	21	31.8 ^{ab}	<0.01
Hay, mixed	64	29.0	22	27.5 ^{ab}	13	17.3 ^a	29	43.9 ^b	<0.01
Haylage, grass	41	18.6	21	26.3	10	13.3	10	15.2	0.08
Haylage, legume	77	34.8	17	21.3 ^a	34	45.3 ^b	26	39.4 ^{ab}	0.01
Haylage, mixed	92	41.6	17	21.3 ^a	36	48.0 ^b	39	59.1 ^b	<0.01
Straw	80	36.2	27	33.8	31	41.3	22	33.3	0.52

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response. Respondents could select multiple choices.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

^{a,b,c} Numbers with different superscripts within a row differ significantly (*P* < 0.05).

Table 8: Frequency of use of selected concentrates and byproducts in lactating rations reported by survey respondents

Select feeds ²	Pan-Canadian Farm Location ¹								<i>P</i> -value ³
	All respondents		WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Barley	74	33.5	55	68.8 ^a	3	4.0 ^b	16	24.2 ^c	<0.01
Beet pulp	18	8.1	15	18.8 ^a	1	1.3 ^b	2	3.0 ^b	<0.01
Brewer's grains	21	9.5	8	10.0 ^{ab}	12	16.0 ^a	1	1.5 ^b	0.01
Bypass fats	118	53.4	54	67.5 ^a	38	50.7 ^{ab}	26	39.4 ^b	<0.01
Canola meal	77	34.8	39	48.8 ^a	28	37.3 ^a	10	15.2 ^b	<0.01
Corn distiller's grains	73	33.0	21	26.3	31	41.3	21	31.8	0.13
Corn gluten meal	23	10.4	8	10.0	11	14.7	4	6.1	0.25
Corn grain, cracked or ground	128	57.9	40	50.0 ^a	40	53.3 ^{ab}	48	72.7 ^b	0.01
Cottonseed	6	2.7	1	1.3	4	5.3	1	1.5	0.23
High moisture corn	52	23.5	4	5.0 ^a	27	36.0 ^b	21	31.8 ^b	<0.01
Molasses	21	9.5	13	16.3 ^a	2	2.7 ^b	6	9.1 ^{ab}	0.02
Roasted soybeans	27	12.2	4	5.0 ^a	9	12.0 ^{ab}	14	21.2 ^b	0.01
Soy hulls	8	3.6	3	3.8	3	4.0	2	3.0	0.95
Soybean meal	125	56.6	31	38.8 ^a	57	76.0 ^b	37	56.1 ^a	<0.01
Wheat	18	8.1	10	12.5 ^a	1	1.3 ^b	7	10.6 ^{ab}	0.03
Wheat distiller's grains	10	4.5	10	12.5 ^a	0	0.0 ^b	0	0.0 ^b	<0.01

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response. Respondents could select multiple choices.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

^{a,b,c} Numbers with different superscripts within a row differ significantly ($P < 0.05$).

For Review Only

Table 9: Frequency of use of selected forages in dry cow rations reported by survey respondents

Select feeds ²	Pan-Canadian Farm Location ¹								<i>P</i> -value ³
	All respondents		WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Corn silage, BMR	25	11.7	3	4.0 ^a	13	18.1 ^b	9	13.9 ^{ab}	0.02
Corn silage, conventional	140	65.7	32	42.1 ^a	58	80.6 ^b	50	76.9 ^b	<0.01
Hay, grass	100	47	55	72.4 ^a	19	26.4 ^b	26	40.0 ^b	<0.01
Hay, legume	20	9.4	12	15.8	3	4.2	5	7.7	0.05
Hay, mixed	66	31	18	23.7 ^a	15	20.8 ^a	33	50.8 ^b	<0.01
Haylage, grass	33	15.5	20	26.3 ^a	6	8.3 ^b	7	10.8 ^{ab}	0.01
Haylage, legume	37	17.4	9	11.8	17	23.6	11	16.9	0.17
Haylage, mixed	46	21.6	7	9.2 ^a	22	30.6 ^b	17	26.2 ^b	<0.01
Straw	101	47.4	38	50.0 ^a	48	66.7 ^a	15	23.1 ^b	<0.01

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response. Respondents could select multiple choices.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

^{a,b,c} Numbers with different superscripts within a row differ significantly ($P < 0.05$).

Table 10: Frequency of use of selected concentrates and byproducts in dry cow rations reported by survey respondents

Select feeds ²	Pan-Canadian Farm Location ¹								<i>P</i> -value ³
	All respondents		WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Barley	44	20.7	34	44.7 ^a	0	0.0 ^b	10	15.4 ^c	<0.01
Beet pulp	10	4.7	6	7.9	3	4.2	1	1.5	0.2
Brewer's grains	11	5.2	5	6.6	5	6.9	1	1.5	0.28
Bypass fats	1	0.5	0	0.0	0	0.0	1	1.5	0.32
Canola meal	42	19.7	17	22.4 ^{ab}	19	26.4 ^a	6	9.2 ^b	0.03
Corn distiller's grains	39	18.3	12	15.8	18	25.0	9	13.9	0.19
Corn gluten meal	6	2.8	1	1.3	4	5.6	1	1.5	0.23
Corn grain, cracked or ground	38	17.8	7	9.2 ^a	12	16.7 ^{ab}	19	29.2 ^b	0.01
Cottonseed	0	0	0	0.0	0	0.0	0	0.0	
High moisture corn	17	8	1	1.3 ^a	7	9.7 ^{ab}	9	13.9 ^b	0.02
Molasses	8	3.8	3	4.0	2	2.8	3	4.6	0.85
Roasted soybeans	7	3.3	1	1.3	1	1.4	5	7.7	0.06
Soybean meal	65	30.5	13	17.1 ^a	31	43.1 ^b	21	32.3 ^{ab}	<0.01
Soy hulls	3	1.4	2	2.6	0	0.0	1	1.5	0.4
Wheat	6	2.8	1	1.3	3	4.2	2	3.1	0.57
Wheat distiller's grains	7	3.3	7	9.2 ^a	0	0.0 ^b	0	0.0 ^b	<0.01

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response. Respondents could select multiple choices.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

^{a,b,c} Numbers with different superscripts within a row differ significantly ($P < 0.05$).

For Review Only

Table 11: Frequency of use of selected forages in lactating rations reported by survey respondents

Select feeds ²	Pan-Canadian Farm Location ¹								<i>P</i> -value ³
	All respondents		WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Corn silage, BMR	19	9.1	2	2.6 ^a	8	11.1 ^{ab}	9	14.5 ^b	0.04
Corn silage, conventional	119	56.7	28	36.8 ^a	49	68.1 ^b	42	67.7 ^b	<0.01
Hay, grass	83	39.5	46	60.5 ^a	23	31.9 ^b	14	22.6 ^b	<0.01
Hay, legume	43	20.5	18	23.7	11	15.3	14	22.6	0.40
Hay, mixed	109	51.9	30	39.5 ^a	37	51.4 ^{ab}	42	67.7 ^b	<0.01
Haylage, grass	35	16.7	21	27.6 ^a	5	6.9 ^b	9	14.5 ^{ab}	<0.01
Haylage, legume	45	21.4	15	19.7	17	23.6	13	21.0	0.84
Haylage, mixed	73	34.8	13	17.1 ^a	38	52.8 ^b	22	35.5 ^b	<0.01
Straw	62	29.5	30	39.5 ^a	26	36.1 ^a	6	9.7 ^b	<0.01

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response. Respondents could select multiple choices.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

^{a,b,c} Numbers with different superscripts within a row differ significantly (*P* < 0.05).

Table 12: Frequency of use of selected concentrates and byproducts in dry cow rations reported by survey respondents

Select feeds ²	Pan-Canadian Farm Location ¹								<i>P</i> -value ³
	All respondents		WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Barley	67	31.9	47	61.8 ^a	7	9.7 ^b	13	21.0 ^b	<0.01
Beet pulp	10	4.8	7	9.2 ^a	0	0.0 ^b	3	4.8 ^{ab}	0.03
Brewer's grains	12	5.7	7	9.2	4	5.6	1	1.6	0.16
Bypass fats	4	1.9	2	2.6	0	0.0	2	3.2	0.33
Canola meal	43	20.5	21	27.6	14	19.4	8	12.9	0.1
Corn distiller's grains	39	18.6	15	19.7	12	16.7	12	19.4	0.88
Corn gluten meal	11	5.2	1	1.3	7	9.7	3	4.8	0.07
Corn grain, cracked or ground	76	36.2	17	22.4 ^a	24	33.3 ^a	35	56.5 ^b	<0.01
Cottonseed	0	0	0	0.0	0	0.0	0	0.0	
High moisture corn	23	11	3	4.0 ^a	10	13.9 ^{ab}	10	16.1 ^b	0.05
Molasses	13	6.2	5	6.6	4	5.6	4	6.5	0.96
Roasted soybeans	9	4.3	0	0.0 ^a	3	4.2 ^{ab}	6	9.7 ^b	0.02
Soy hulls	2	1	0	0.0	0	0.0	2	3.2	0.09
Soybean meal	69	32.9	12	15.8 ^a	33	45.8 ^b	24	38.7 ^b	<0.01
Wheat	7	3.3	4	5.3	2	2.8	1	1.6	0.47
Wheat distiller's grains	6	2.9	6	7.9 ^a	0	0.0 ^b	0	0.0 ^b	<0.01

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Percentages indicate % of total respondents in pan-Canadian farm location who chose the response. Respondents could select multiple choices.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

^{a,b,c} Numbers with different superscripts within a row differ significantly ($P < 0.05$).

For Review Only

Table 13: Survey responses attitudes towards ration balancing for different management groups

	Pan-Canadian Farm Location ¹				<i>P</i> -value ³
	All	WP	OF	OT	
	respondents				
	Ranking (1-5 scale) ²				
Lactating cow nutrition management factors ranking					
Performance	1.5	1.5	1.4	1.5	0.43
Cost	3.5	3.7 ^a	3.2 ^b	3.5 ^{ab}	0.02
Simplicity	3.8	3.9	3.8	3.6	0.14
Nutrient management	4.2	3.7 ^a	4.5 ^b	4.3 ^b	<0.01
Health	2.1	2.2	2.0	2.1	0.77
Dry cow nutrition management factors ranking					
Performance	1.9	2.1 ^a	1.7 ^b	1.7 ^b	0.01
Cost	3.6	3.8 ^a	3.5 ^b	3.6 ^{ab}	0.04
Simplicity	3.5	3.6	3.5	3.4	0.36
Nutrient management	4.2	3.6 ^a	4.6 ^b	4.3 ^b	<0.01
Health	1.8	1.8	1.7	2.0	0.11
Heifer nutrition management factors ranking					
Performance	1.7	1.9 ^a	1.5 ^b	1.7 ^{ab}	0.03
Cost	3.6	3.8	3.5	3.6	0.08
Simplicity	3.3	3.4	3.2	3.2	0.52
Nutrient management	4.1	3.7 ^a	4.5 ^b	4.3 ^b	<0.01
Health	2.3	2.2	2.3	2.3	0.59

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² From a score of 1 to 5, with 1 being most important and 5 being least important.

³ Overall effect of pan-Canadian farm location (WP, OF, and OT)

^{a,b,c} = Numbers with different superscripts within a row differ significantly per question ($P < 0.05$).

For Review Only

Table 14: Agreement of survey respondents to statements regarding feeds

	All respondents		Pan-Canadian Farm Location						<i>P</i> -value ²
			WP		OF		OT		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
"I am willing to incorporate new feeds into rations."									0.96
Strongly agree	42	19.6	18	23.4	15	35.7	9	21.4	
Agree	78	36.4	31	40.3	24	33.3	21	35.4	
Somewhat agree	55	25.7	17	22.1	20	27.8	18	27.7	
Neither agree nor disagree	28	13.1	7	9.1	10	13.9	11	16.9	
Somewhat disagree	3	1.4	1	1.3	1	1.4	1	1.5	
Disagree	5	2.3	2	2.6	1	1.4	2	3.1	
Strongly disagree	3	1.4	1	1.3	1	1.4	1	1.5	
"Feedstuffs should be tested frequently."									0.02
Strongly agree	73	34.1	31	39.7	27	37.5	15	23.4	
Agree	93	43.5	36	46.2	29	40.3	28	43.8	
Somewhat agree	29	13.6	9	11.5	9	12.5	11	17.2	
Neither agree nor disagree	10	4.7	1	1.3	3	4.2	6	9.4	
Somewhat disagree	3	1.4	1	0.5	0	0.0	2	3.1	
Disagree	4	1.9	0	0.0	4	5.6	0	0.0	
Strongly disagree	2	0.9	0	0.0	0	0.0	2	3.1	
"Rations should be rebalanced often."									0.30
Strongly agree	58	27.2	20	25.6	24	34.3	14	21.5	
Agree	75	35.2	28	35.9	24	34.3	23	35.4	
Somewhat agree	50	23.5	20	25.6	15	21.4	15	23.1	
Neither agree nor disagree	16	7.5	6	7.7	3	4.3	7	10.8	
Somewhat disagree	4	1.9	3	3.8	0	0.0	1	1.5	
Disagree	8	3.8	1	1.3	4	5.7	3	4.6	
Strongly disagree	2	0.9	0	0.0	0	0.0	2	3.1	

¹ WP = Western Provinces (British Columbia, Alberta, Saskatchewan and Manitoba); OF = Ontario freestall; OT = Ontario tiestall.

² Overall effect of pan-Canadian farm location (WP, OF, and OT)

For Review Only