Body Condition and Lameness Scores of Oklahoma State University Dairy Cows Over Time

Abstract

In this study the body condition scores (BCS), lameness scores, and milk production (factors) of 16 Jersey and 16 Holstein cows from the Oklahoma State University (OSU) dairy herd were recorded to reveal patterns over a span of several months. The milk production factors included: lactation number, days in milk (DIM), milk production, fat %, protein %. Data were collected 4 times across 3 months using a standard BCS and lameness scoring scale. The objective of this project was to assess the cows' lameness and body conditions to see how it related to their milk production. The study showed that the Jerseys had generally higher BCSs than were ideal, and the Holsteins had generally lower BCSs than were ideal. Lameness scores of both breeds were well below industry benchmarks with only 3 instances of lameness throughout the entire study. The relationships between BCS, lameness, and milk production factors generally did not follow the same patterns found in other similar studies, although there were a few differences that could be explained by the sample size studied and by the breed types.

Introduction

A dairy cow's body condition score (BCS) is a subjective assessment designed to convey the proportion of body fat that the cow in question possesses (Roche et al., 2009). It is a 5-point scale with 0.25 point increments where a minimum score of 1 means that the cow is incredibly underweight and a 5 would mean she is incredibly overweight. The cow is rated based on visual assessments of her back and hindquarters, specifically the hooks, pins, tail head, spinal vertebrae, and the areas between these points.

A score of 1 would be marked by very visible and defined spinal vertebrae, and hooks and pins would also be minimally covered and sharp. This would be accompanied by a dramatic depression between the hooks and pins and also one between the pins and tail head, making the tail head appear to be carved out of the rest of the body. A cow should never be allowed to reach this low a score.

A score of 2 would mean that the spine, while still visible, is not prominent and individual vertebrae not be easily distinguishable. The hooks and pins are still prominent but the depression between them is less dramatic, as is the one between the pins and tail head. The tail head appears to jut out less from the rest of the body.

A score of 3 indicates that the spine appears to almost be one bone and individual vertebrae are not visible. The hooks and pins, instead of appearing sharp, are rounded and smooth looking. The space between the pins and tail head is smooth instead of indented but without apparent fat deposition.

A score of 4 will reveal no individuality in the spine without firm palpitation and appears to flow smoothly into the rest of the body, not rise up out of it. The entire back end should appear more filled out with no sharp edges. The space between the pins and tail head is now flat with signs of deposited fat, and the spaces between the hooks and pins is no longer concave but has a flatter appearance.

A score of 5 essentially means that the bones are all buried in fat. The spine, hooks, and pins, are all barely visible and the tail head itself is covered and surrounded by fat (Wildman et al., 1982).

Banos et al., (2004) shows that a cow's BCS begins to fall at the beginning of lactation and continues falling until roughly about midway through where it begins to climb until the cow is dried off. As her milk yield increases so does the draw on her body until it tips the scales and exceeds the amount of energy she is taking in. This causes her to lose conditioning, but as milk production slacks she gains her conditioning back. Therefore, milk yield levels and BCS levels are roughly inverses of each other.

Each stage of lactation has an ideal BCS for the cows in that stage. Calving (DIM = 0) is the start of the cycle and the ideal BCS for cows in that stage is 3.5. Early lactation's (DIM = 1-30) ideal BCS is 3.0. Peak milk (DIM = 31-100) has an ideal BCS of 2.75. From there it begins to increase again with mid lactation's (DIM = 101-200) ideal being 3.0. Late lactation's (DIM = 201- 300) ideal is a 3.25. The dry off (DIM = >300) and completely dry stages both have an ideal BCS of 3.5 (Heinrichs et al., 2001).

Lameness is when an animal has an abnormal stance or gait and is an increasingly recognized issue in the dairy industry as it decreases an animal's well-being and has the potential to seriously stunt a dairy cow's lifetime performance (Randall, L. V., et al., 2016). It is recognized as one of the three most costly dairy diseases, mostly due to its negative impacts on milk production and reproductive performance (Ranjbar, 2016).

There are several different things that can cause lameness. One study, (Huxley, 2013), even describes lameness as, "not a single condition, rather it is a symptom of a wide range of different diseases." A few conditions that lead to lameness are: sole hemorrhages, white line lesions, double soles, sole ulcers, interdigital hyperplasia, digital dermatitis, heel horn erosions, and interdigital dermatitis. (It is important to note that for this study a lameness score of 3 is the minimum to be considered lame.) Capion et al., 2009 studied the prevalence of these conditions across the various stages of lactation in 147 heifers and found that the incidence steadily increased from 25% of the studied cows being lame at the very beginning of lactation (DIM = 0), to 50% at DIM 1-100, to 66% at DIM 101-200, and finally to the peak of 90% at DIM 201-300, after which it dropped back down to 70% at DIM > 300.

A dairy cow's level of lameness is assessed visually using a 5-point scale.

A score of 1 (normal) is given to cows demonstrating a normal gait that both stand and walk with a level back.

A score of 2 (mildly lame) indicates that while the cow stands with a level back, she walks with an arched back. Her gait is still normal.

A score of 3 (moderately lame) indicates that the cow will both stand and walk with an arched back. Her gait is no longer normal and will have a short stride with one or several of her feet.

A score of 4 (lame) indicates that the affected cow has a constantly arched back and walks with a deliberate step, probably favoring one or more of her limbs/feet.

A score of 5 (severely lame) indicates that the cow might not want, or is unable, to put any weight at all on one or more of her feet and might be hesitant to walk at all (Sprecher et al., 1997).

Foditsch, 2016 states that, in a study of 23 large dairy farms in upstate New York, the average rate of lameness was 14% for a score of 2 or greater, and 2% for a score of 3 or greater at drying off. For BCS, the average was a score of 3.5 also at drying off.

The objective of this study was to assess the body condition scores and the incidence of lameness of Jersey and Holstein dairy cows at the OSU Dairy Cattle center and to compare those rates with benchmark industry standards. An additional objective was to determine the relationships between the following variables: body condition score, lameness, milk yield, stage of lactation, milk fat percentage, and milk protein percentage within Jersey and Holstein cows. Knowing this will help the OSU Dairy see how they compare to other dairies and decide if they need to make any changes to their herd management practices.

Methods

Data were collected at the OSU Dairy Center on August 26th, September 9th, October 7th, and October 21st starting at roughly 2:00 p.m. each day in the year 2016. Cows were randomly selected to be enrolled in the study on August 26th. They were selected by dedicating 1 hour to the Jersey pen and then 1 hour to the Holstein pen and recording the BCS and lameness scores of as many as possible within the allotted time.

On each collection date after that the same cows were found and re-scored; cows that could not be located (e.g. if they had been moved to another pasture to dry off) were removed from the list. After 4 scoring days that left 32 total cows (16 Jerseys and 16 Holsteins) that were scored on every scoring day. Their BCSs were collected by the same researcher every time using Figure 1 as a guide. Their lameness scores were also only collected by one researcher and based on Figure 2's scoring system. Only one researcher was used so that the scores would be consistent and would not be subjected to several different people's unique biases.

To record the data, the researcher brought a clip board with the tag numbers of all the cows included in the study listed. From there each cow on the list was found, not necessarily in order, and evaluated for a BCS score before being given a lameness score. If the cow refused to stand due to severe lameness her BCS was not recorded.

Once all the data had been collected it was organized into an Excel spreadsheet and graphed. The Proc Corr procedure of SAS version 9.4 (SAS Institute, Cary, NC) was used to determine Pearson correlation coefficients between variables. Significance was declared at $P<0.05$ and trend at $P<0.1$.

Results

Figures 3 (Jerseys) and 4 (Holsteins) show the correlation between the cows' BCS and DIM. The correlation between BCS and DIM was significant ($P<0.05$) for both breeds, but the Holstein data was considerably more significant with $P<0.0001$.

Figures 5 (Jerseys) and 6 (Holsteins) show the correlation between the cows' DIM and milk production. Once again both breeds showed significant correlations between the two factors, but the Holstein significance was $P<0.0001$.

Table 1 (Jerseys) and 2 (Holsteins) show simple statistics for both breeds. These statistics include the number, mean, standard deviation, minimum, and maximum for the BCS, number of lactations, milk production, lameness, DIM, fat %, and protein %. The average Jersey lameness score was a 1.25, while the average Holstein lameness score was a 1.13.

Table 3 shows correlations between BCS, lameness, and milk production factors for both the Jerseys and Holsteins. Significant correlations noted in both breeds include correlations between: BCS and milk production, BCS and DIM, BCS and protein %, # of lactations and milk production, milk production and DIM, milk production and fat %, and DIM and protein %. Milk production and protein %, and lameness and DIM, were correlated as a trend in Jerseys and significant in Holsteins. DIM and fat % were significantly correlated in Jerseys but were only a trend in Holsteins. In only Jerseys, there was significance between # of lactations and lameness, and lameness and fat %. In only Holsteins, there were trends between BCS and # of lactations, BCS and lameness, BCS and fat %, # of lactations and fat %, and milk production and lameness; and there was a significant correlation between fat % and protein %.

Table 4 displays the p values and r values of various relationships between: BCS, lactation number, milk production, lameness, DIM, fat %, and protein %. The r values are in the top right corner of the table and the p values are in the bottom left corner. This table essentially shows all of the same correlations from Table 3, but also includes the relationships that had no correlation for either breed. It also shows if they were negatively or positively correlated.

Table 5 shows the average BCS for both breeds across the different stages of lactation along with their deviation from the ideal BCS. At DIM 1-30, the average Jersey BCS was 2.92 and the average Holstein BCS was 2.75. At DIM 31-100, the average Jersey BCS was 2.99 and the average Holstein BCS was 2.67. At DIM 101-200, the average Jersey BCS was 3.06 and the average Holstein BCS was 2.79. At DIM 201-300 the average Jersey BCS was 3.38 and the average Holstein BCS was 3.28. At DIM >300 there were no Jerseys recorded and the average Holstein BCS was 3.26.

Discussion and Conclusion

Lameness is an extremely important issue in the dairy industry as it can negatively affect a cow's milk production, reproductive success, and how long she continues to be productive (Von

Keyserlingk et al., 2012). One study, (Wells et al., 1993), found that there was an increase in rates of lameness with number of lactations. The same was not found in this study, with a negative significant correlation of *P*=0.0455. However, this correlation only existed in Jerseys; Holsteins did not display a correlation of any significance between the two factors. It should be noted that in this study there were very few cows that scored high enough to be considered lame so that sample size is very small.

Espejo (2010) found no correlation between DIM and lameness, which was also different in this study. Jerseys showed a negative trend between the two and Holsteins showed negative significance. The article noted that dissimilar results had been found in other studies.

Another study, (Barkema et al., 1994), found that lameness had a tendency to increase with intense milk production. This study had different implications with *P*=0.0512, meaning a negative trend, in Holsteins. The Jerseys showed no correlation. This study also found a negative trend (for Holsteins only) between BCS and lameness, which (Wells et al., 1993) also found. That study was careful to note, though, that it could be the lameness causing the low BCS score, not the BCS causing the lameness. A cow that is lame might have a harder time getting to feed and could lose weight as a result. In a study of Holstein dairy cows, (Juarez et al., 2003) noted that as the cows' lameness scores increased, their milk production decreased. This makes sense especially in connection to the previous article's findings: if the cow's BCS is dropping, it makes logical sense that her milk production should too, although this study did not reflect such findings.

Cook et al., (2016) noted that the average dairy farm for that study had a 10.7% rate of lameness (with a score of 3), with a less than 3% rate for higher scores. In this study, the average Jersey cow out of all 16 had a locomotion score of 1.25, while the average Holstein had a score of 1.13. It should also be noted that there was one, and only one, cow with a lameness score of 5 throughout the entire study.

A negative trend between Holstein BCS and number of lactations was also found in this study, but there was no significant correlation between the same factors in Jerseys. Ferris et al., (2014) found dissimilar results to our Holsteins with commercial dairy Holstein-Friesian crosses. In that study, the first lactation followed the usual BCS fluctuation pattern (it decreased until roughly mid lactation, then began increasing). During the second lactation, however, the BCS steadily climbed throughout the entire lactation period indicating a positive correlative relationship. The difference between the two studies' results could be due to the sample sizes. This study used a total of 32 cows, 16 of each breed, from one dairy center while the Ferris et al. (2014) study used 19 total dairy farms, each predominantly Holstein-Friesian herds, with at least 60 cows each.

The OSU Dairy Center's instances of lameness were drastically below average with 0% lameness (with a score of 3 or above meaning lame) in Holsteins across all DIM, and 0.06% of Jerseys lame in DIM 1-100, and 0.04% lame in DIM 101-200. All that together means that at its absolute worst, only 0.02% of the OSU Dairy herd sample was lame, and they were all Jerseys.

It is interesting to note that all of the occurrences of lameness were recorded during the October 7th collection day.

The average BCS of the Jerseys was higher than the ideal scores in all stages of lactation except DIM 1-30 where their average was slightly lower. There were no Jerseys with DIM > 300, so no data exists in that category. The Holstein BCS was lower than ideal in every category except DIM 201-300 where it was very slightly higher. It is important to note that there was only one Holstein that fell in the DIM 1-30 category. The average deviation from the ideal BCS, across all stages of lactation and both breeds, was 0.15. The BCS differences between breeds can partially be explained by the OSU Dairy's rationing: both breeds receive the same ration regardless of size differences.

In conclusion, the patterns found in this study mostly do not line up with findings in similar studies and the differences could be attributed to the breeds involved in the studies and, mostly, the sample sizes. As far as industry benchmarks, the OSU Dairy Center had an extraordinarily low percentage of lame cows (of either breed) compared to other studies, and the Jerseys had a generally higher BCS than the ideal, while the Holsteins were generally lower than ideal, but no lactation category (of either breed) deviated from the ideal BCS by more than 0.25 at any point.

Figure 1: Chart for scoring dairy cow body condition (Wildman et al., 1982)

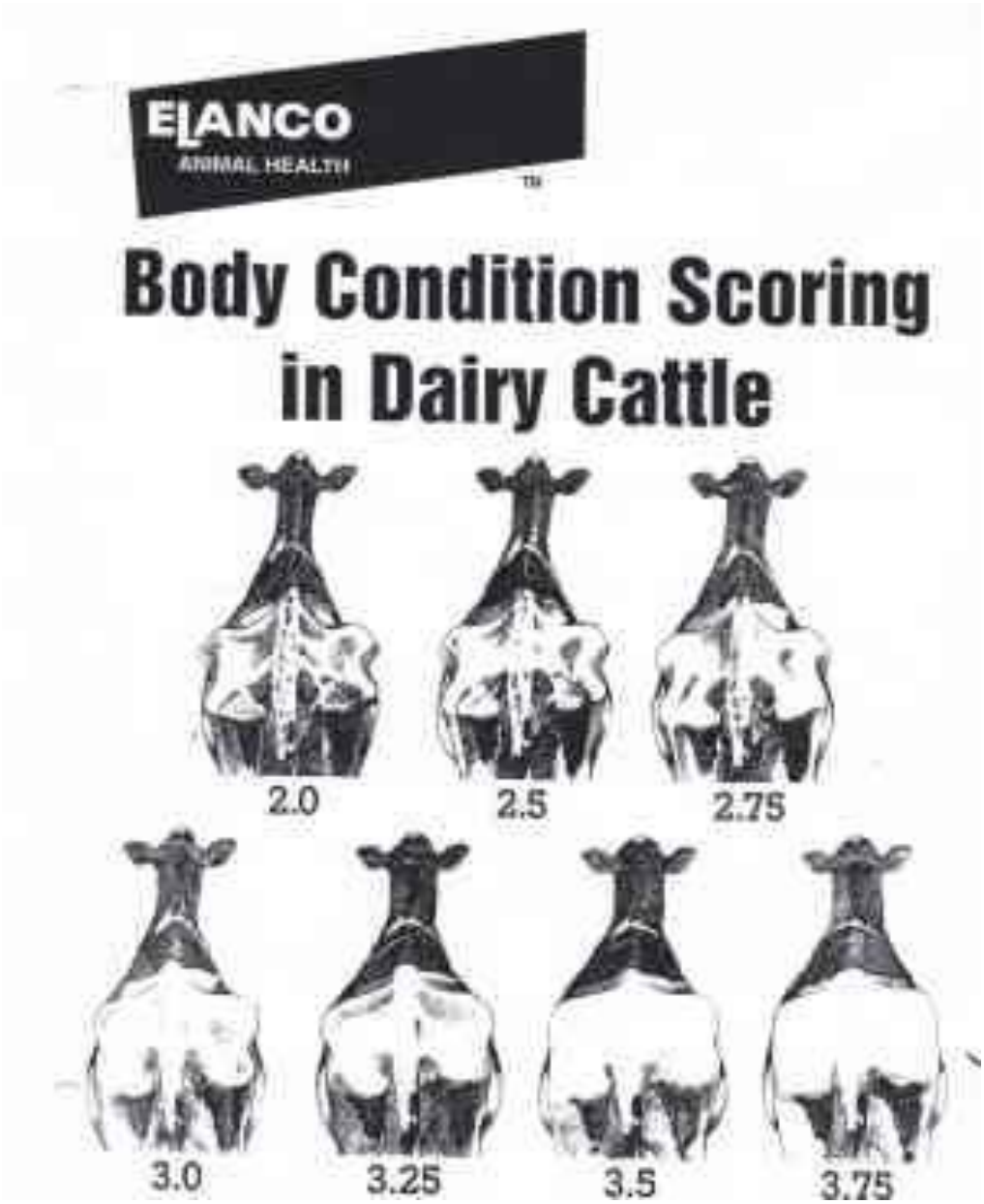

Figure 2: Chart for scoring dairy cow locomotion (Sprecher et al., 1997)

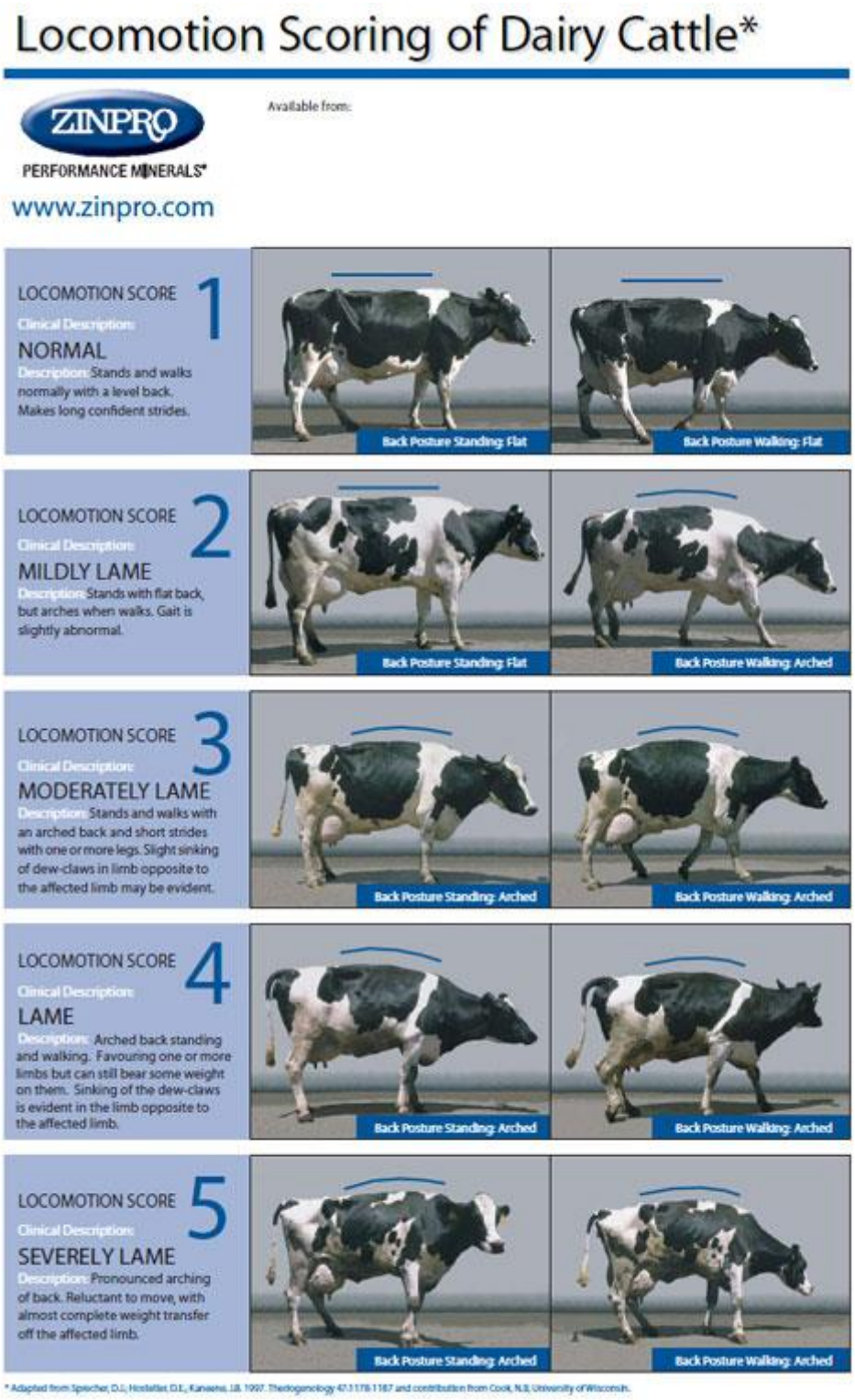

Figure 3: Jersey BCS compared to DIM

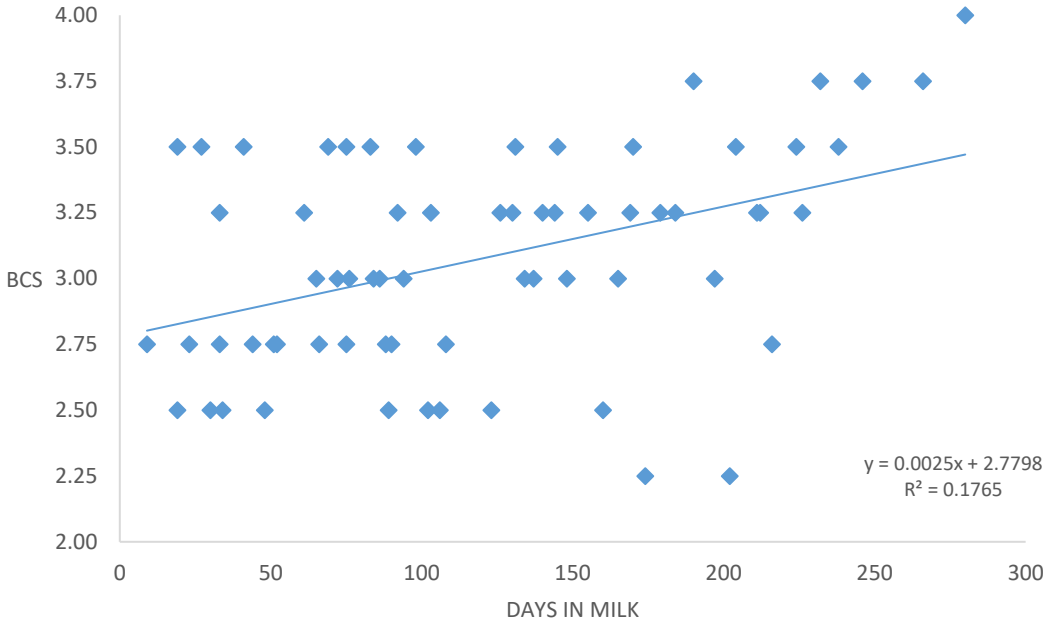

Figure 4: Holstein BCS compared to DIM

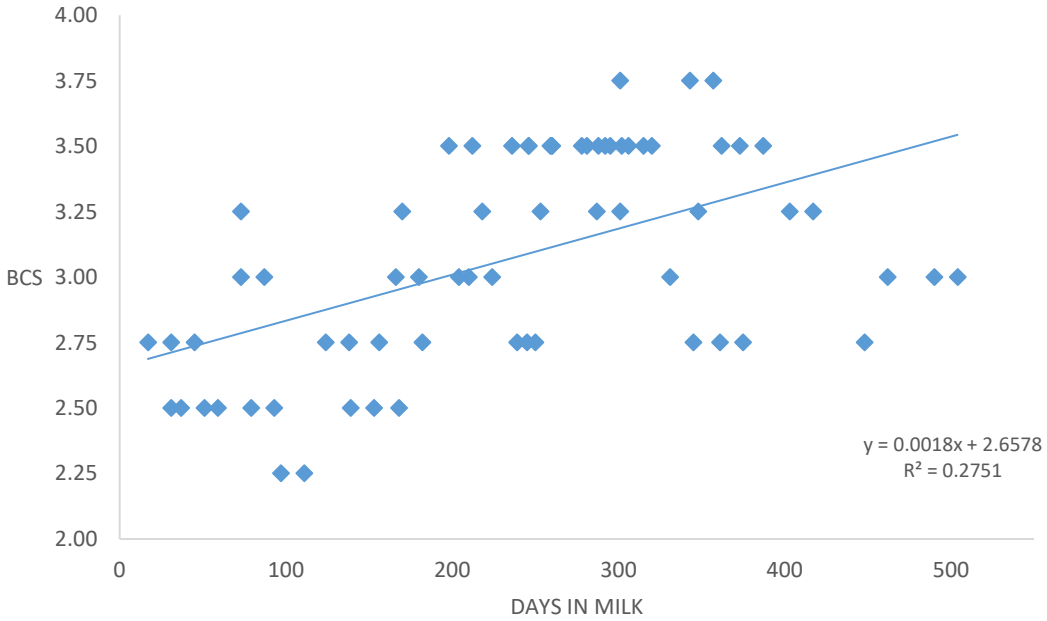

Figure 5: Jersey DIM compared to milk production

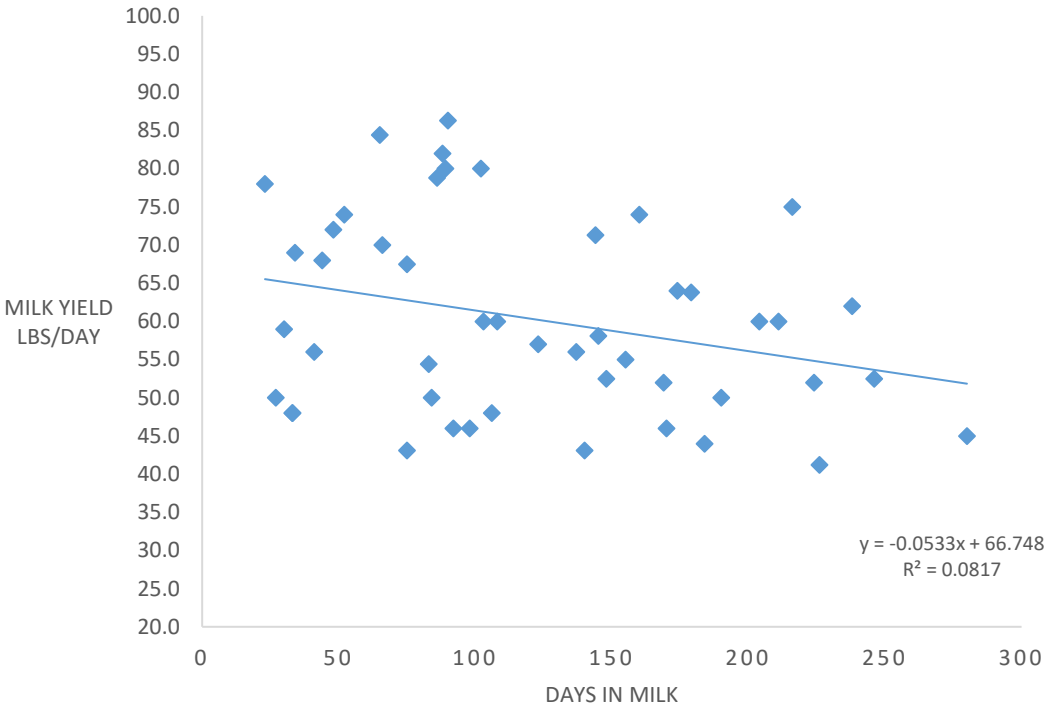

Figure 6: Holstein DIM compared to milk production

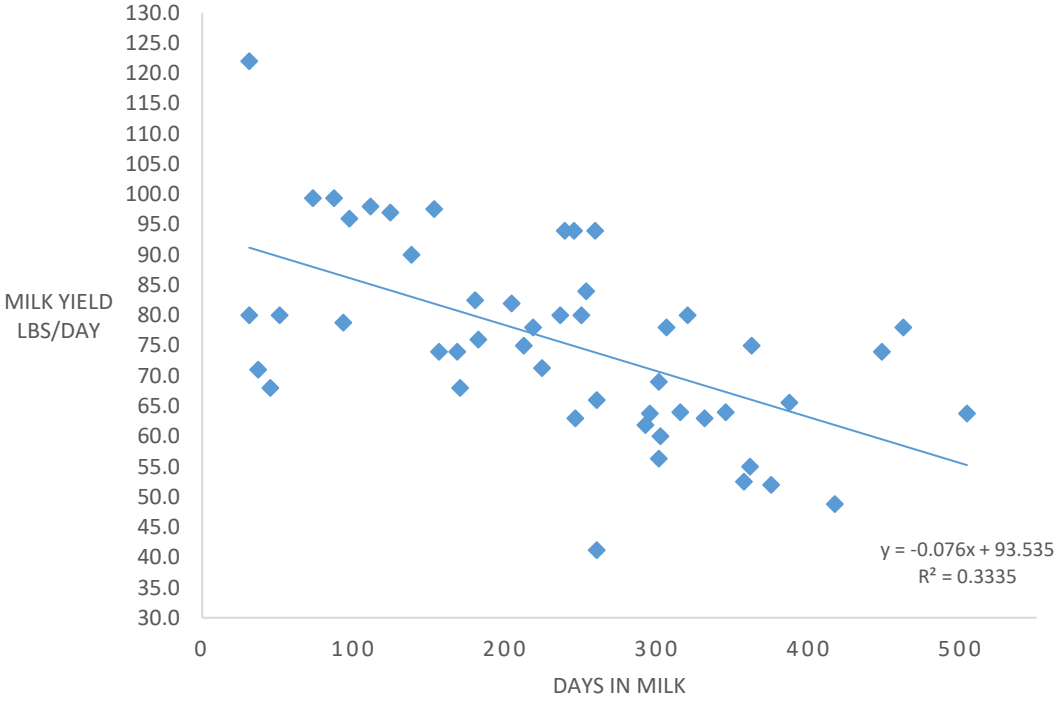

Table 1: Jersey Simple Statistics for BCS, lameness, and milk production factors

Variable	N	Mean	SD	Minimum	Maximum
BCS	67	3.08	0.411	2.25	4.00
# Lactations	68	3.29	1.75	1.00	5.00
Milk	48	60.27	12.66	41.20	86.30
Lameness	68	1.25	0.70	1.00	5.00
Days in Milk	68	120.06	69.82	9.00	280.00
Fat %	34	4.31	0.70	2.30	5.50
Protein %	34	3.64	0.34	3.10	4.20

Table 2: Holstein Simple Statistics for BCS, lameness, and milk production factors

Variable	N	Mean	SD	Minimum	Maximum
BCS	68	3.07	0.41	2.25	3.75
# Lactations	68	1.94	1.12	1.00	4.00
Milk	50	75.58	15.74	41.20	122.00
Lameness	68	1.13	0.34	1.00	2.00
Days in Milk	68	236.65	121.68	17.00	504.00
Fat %	34	3.55	0.69	2.10	5.00
Protein %	34	3.33	0.37	2.40	4.10

Table 3: Correlations between BCS, lameness, and milk production factors for Jerseys and Holsteins

Factor 1	Factor 2	Jerseys	Holsteins
BCS	**Milk Production**	0.0003*	0.0006*
BCS	**DIM**	0.0004*	<.0001*
BCS	**Protein %**	0.0012*	0.0053*
BCS	**# Lactations**	0.4936	0.0835~
BCS	**Lameness**	0.4770	0.0571~
BCS	**Fat %**	0.1142	0.0734~
# Lactations	**Milk Production**	0.0002*	0.0074*
# Lactations	**Fat %**	0.1489	0.0895~
# Lactations	**Lameness**	0.0455*	0.4223
Milk production	**DIM**	0.0489*	<.0001*
Milk production	**Fat %**	0.0028*	0.0145*
Milk production	**Protein %**	0.0983~	<.0001*
Milk production	**Lameness**	0.5839	0.0512~
Lameness	**DIM**	0.0685~	0.0131*
Lameness	**Fat %**	0.0204*	0.9329
DIM	**Protein %**	<.0001*	<.0001*
DIM	**Fat %**	0.0128*	0.0571~
Fat %	**Protein %**	0.1673	0.0025*

*** Indicates significance**

~ Indicates a trend

Table 4: r values (top right corner) and p values (bottom left corner) for the relationships between various milk production factors

Jersey Holstein	BCS	# Lactations	Milk lbs/day	Lameness	DIM	Fat %	Protein %
BCS		0.08509 -0.21141	-0.50113 -0.47025	-0.08838 -0.23186	0.42017 0.52449	0.27592 0.31099	0.53250 0.46718
# Lactations	0.4936 0.0835~		0.51081 0.37419	-0.24343 0.09890	-0.10934 -0.19717	-0.25296 -0.29573	0.20355 0.12722
Milk lbs/day	0.0003* 0.0006*	0.0002* 0.0074*		-0.08106 0.27730	-0.28583 -0.57751	-0.49704 -0.41548	-0.28822 -0.71395
Lameness	0.4770 0.0571~	0.0455* 0.4223	0.5839 0.0512~		-0.22227 -0.29958	-0.39619 -0.01499	-0.09787 -0.25564
DIM	0.0004* <.0001*	0.3748 0.1070	0.0489* <.0001*	0.0685~ 0.0131*		0.42241 0.32948	0.62299 0.69311
Fat %	0.1142 0.0734~	0.1489 0.0895~	0.0028* 0.0145*	0.0204* 0.9329	0.0128* 0.0571~		0.24235 0.50226
Protein %	0.0012* 0.0053*	0.2482 0.4734	0.0983~ <.0001*	0.5819 0.1445	<.0001* <.0001*	0.1673 0.0025*	

Table 5: Jersey and Holstein average BCS across all stages of lactation compared to ideal BCS

DIM	Ideal BCS	Avg. Jersey BCS	Avg. Holstein BCS	Jersey Deviation	Holstein Deviation
1-30	3.0	2.92	2.75	- 0.08	- 0.25
31-100	2.75	2.99	2.67	+ 0.24	- 0.08
101-200	3.0	3.06	2.79	+ 0.06	- 0.21
201-300	3.25	3.38	3.28	+ 0.13	+ 0.03
>300	3.5	No Data	3.26	No Data	- 0.24

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