Transition Cow Index™

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Abstract

A tool called the Transition Cow Index (TCI) has been developed to objectively evaluate the effectiveness of transition cow management at the herd level. Fourteen factors from the historical Dairy Herd Improvement Association (DHIA) record of each individual cow are used to predict her milk yield and projection at her first test date, a date that frequently overlaps with fresh cow disease periods. Deviations from her expected milk yield are calculated and used at the herd level to evaluate the overall effectiveness of transition cow management programs. TCI offers dairy managers and consultants an objective tool to benchmark current programs and monitor the effectiveness of interventions.

Résumé

Un outil appelé le *Transition Cow Index* (TCI) a été développé afin d'évaluer objectivement l'efficacité de la régie des vaches en transition au niveau du troupeau. Un total de 14 facteurs tirés des dossiers antécédents du contrôle laitier de chaque vache sont utilisés pour calculer la production de lait attendue et la projection au premier test. Cette date coïncide souvent avec la période de plus grande vulnérabilité aux maladies chez les vaches vêlées récemment. La déviation par rapport à la production de lait attendue est calculée et utilisée au niveau du troupeau pour évaluer dans son ensemble l'efficacité du programme de régie des vaches en transition. Le TCI donne aux gestionnaires des fermes laitières et aux consultants un outil objectif pour comparer la valeur des programmes en place par rapport aux normes actuelles et évaluer l'efficacité des interventions.

Introduction: Weaknesses of Current Monitors

Workers at the cow and herd level within the dairy industry know that if a cow passes the transition period of three weeks before and after calving without problems, her subsequent lactation is likely to be successful. For that reason, much attention and experimentation in both research units and commercial dairies has been focused on the management of cows during this critical period of time. Attempts to evaluate the performance of transition cows have usually focused on either rates of disease or milk production at test days early in lactation, but both approaches have severe limitations.[1]

Problems in the use of disease rates to monitor transition cow programs include inconsistencies in case definition between workers, inconsistent recording of events and the relatively low frequency of disease events. Veterinarians generally consider the diagnosis of displaced abomasum (DA) to be the most consistently recorded diagnosis in on-farm records. Even though the diagnosis may be relatively consistent, the low frequency makes over interpretation of records common. For example, chi square analysis indicates only 60% certainty that six DA's in 100 fresh cows this month is actually different from three DA's in 100 last month. Monitoring the rates of less consistently recorded events, such as metritis and ketosis, becomes even less useful.

While disease rates can be maintained with enough consistency to be used to monitor trends over time in a single herd, those records cannot be successfully used to compare transition programs between herds. Without definable industry benchmarks, dairy herd managers tend to view the prevalence of problems in their herd as normal, and many accept an abnormal frequency of problems as normal.

Production-based monitors usually compare average performance of cohorts of cows that calve over a short period of time, such as a month or week, to cohorts from other periods of time. Examples include first-test 305-day milk projections, peak milk and others. These monitors are based upon a single test day and are easily skewed by superior or inferior cows that happen to calve during the same time period, and may be biased by variations in days-in-milk (DIM) at test date. Used cautiously, these monitors can indicate a change in herd trends over time. However, they are still limited in that transition programs cannot be fairly compared between herds using these monitors, as they reflect several factors in addition to transition management. For example, average first-test-day milk yield of 85 lb (38.6 kg) per cow is influenced by cow quality, DIM at first test and transition management.

Another monitor, called first-test 305-day projected milk, reflects both cow quality and transition program management, but also production level of the herd. The herd production level effect means that an individual cow producing 80 lb (36.4 kg) at 15 DIM will have a higher first-test 305-day projection if she is tested in a high producing herd than if she is tested in a low producing herd.[6,7] Because of these factors, transition programs cannot be compared fairly between herds using

these indices. When used to monitor progress in a single herd, this index can again be skewed by cohorts of cows of different quality that calve within the specified period of time.

The old adage comes to mind: If you can't measure it, you can't manage it. Modified slightly, if you can't measure it accurately, you can't manage it well. In short, our ability to manage the most critical phase of a dairy cow's life has been limited by marginal quality monitors of transition cow performance. Low quality monitors and the absence of quantifiable benchmarks engenders complacency regarding fresh cow disease within our industry.

Transition Cow Index™ Uses Each Cow as Her Own Control

A Transition Cow Index™ (TCI) has been developed to objectively monitor the performance of fresh cows. TCI uses DHIA data from the previous lactation in an equation to predict performance at the first test day of the new lactation, compares actual performance to that predicted, and the difference is TCI.

The prediction component of TCI was developed using DHIA data from approximately 500,000 cows in over 4,000 herds and was accessed from AgSource, Inc., a Wisconsin DHIA service. Because prior production would be influenced by use or non-use of Posilac[a], Monsanto, Inc. assisted in matching herd purchase patterns of Posilac with the AgSource herds which were classified as consistent purchasers of "Label" use of Posilac in the herd, "Medium", "Low", "Inconsistent", and "None". Using the Mixed Procedure in SAS,[5] a model was developed to predict the first-test milk weight and a first-test 305-day milk projection (without a herd production effect). Using SAS, parameter values were obtained by fitting a mixed effects model to the dairy cow data. Effects used in the final model include DIM at first test (limited to the interval from five to 40 DIM), previous 305-day milk, DIM in prior lactation, start of current lactation as calving or abortion, start of prior lactation as calving or abortion, month of calving, somatic cell count (SCC) log score at last test of prior lactation, days dry, milking frequency current lactation, milking frequency prior lactation, parity number, breed and Posilac use at the herd level. Essentially, the model predicts the first-test milk and 305-day projection for each cow based upon the average first-test performance of cows with that same history in all those variables.

Relevance to Transition Cow Health

The first DHIA test date for the typical cow occurs at a median 18 DIM, but ranges from five to about 38 in monthly testing programs. Various studies show the median DIM at diagnosis of common fresh cow diseases such as metritis, ketosis, displaced abomasa, off feed, enteritis and mastitis, as well as their adverse effects on production, overlapping the median first-test date.[2,3] This suggests that first-test-day milk yield is potentially related to fresh cow health. At the individual cow level, for example, there will be individual cows tested at six DIM that develop a displaced abomasum at 25 DIM with no adverse effect on first-test milk yield. At the herd level, however, the Transition Cow Index based upon deviation from expected first-test- milk yield is likely to reflect fresh cow health of the herd.

Validation of TCI as an Indicator of Transition Cow Health

While on-farm disease event records have serious problems as discussed above, TCI must be validated using disease records despite their limitations. Private herd health records for 18,814 cows in 30 herds were collected, and the date of diagnosis of selected diseases was related to the first milk recorded date after calving. Cows with disease events prior to or within seven days following their first test date were compared to cows without noted diseases within the same time period. The results are summarized in Table 1.

Somatic cell counts serve as the single objective disease monitor in DHIA records. AgSource records from 163,624 cows were sorted by first-test SCC linear score, and TCI averages were calculated by SCC linear score group. Each unit of SCC linear score was associated with an average loss of 436 lb (198.2 kg) TCI. This value is very similar to prior work that associates each increasing unit of SCC linear score with a loss of approximately 440 lb (200 kg) per lactation for mature cows.[4]

Using TCI to Benchmark Herd Transition Programs

TCI values were calculated for all cows and herds in the AgSource record system. Herd average TCI scores for all cows over a one-year period of time are presented in Figure 1 as a histogram. Because the predicted first-

Table 1. Average TCI values for cows with disease entries in Dairy Comp 305 records from 30 herds.

Event	TCI (lb)	Std Error
None	136	86
Metritis	-539	603
Ketosis	-2457	537
Lameness	-2829	656
Displaced abomasum	-6041	1032

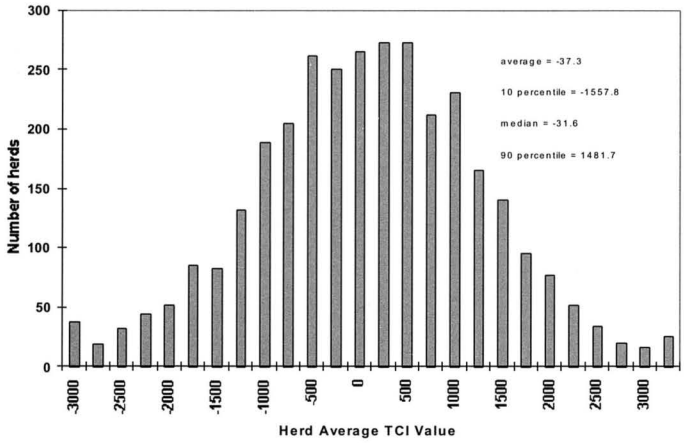

Figure 1. Histogram of herd average TCI values of AgSource dairy herds.

test value used in the TCI calculation represents the average performance of cows with similar histories (age, prior production, days dry, prior SCC, etc.), it is not surprising that the median herd average TCI value is near zero. However, the range indicates that herd-level transition programs have an effect of more than 7,000 lb (3,181 kg) on first-test projections. Benchmarks are expressed as TCI levels for the 90th percentile, average, and 10th percentile levels.

The effectiveness of individual herd transition programs can be benchmarked relative to the rest of the industry. The ability to identify truly superior transition cow management programs is valuable to people who study the issue, and it can be helpful in motivating change to improve transition management on commercial dairies.

Use of TCI in to Monitor Transition Management Programs

A graph developed to monitor transition management programs over time is shown in Figure 2. Each dot on the scatterplot represents a single cow and shows her TCI value above her most recent calving date. Individual cows with TCI's greater than +/- 6,000 lb (2,727 kg) are not shown on the graph, but are included in the summary calculations.

Because the TCI index attempts to quantify the herd transition management program, it is important to not overlook individual cows that fail. In the system that has been developed with AgSource, all cows that have a first-test milk recorded are included in the TCI calculations and graph for 365 days. This includes cows that are culled from the herd or that die after the first test date. It also includes cows where milk was measured, but were given a "condition affecting record" (CAR) code. For example, if a fresh cow is sick with mastitis, dairy managers can code that test date with a CAR code and that (usually low) milk weight is not used in the cow's lactation record. However, that milk weight is used to compute the TCI value.

The line that runs through the middle of the graph represents a rolling average TCI value, and above the graph are TCI averages for 90-day intervals. In herds of greater than 250 cows, the calculated value represents all calvings over the prior 30 days. The line and value serve as ongoing monitors of transition cow management for the specific dairy. In the example shown in Figure 2, the dramatic increase in TCI shown by cows calving in January was associated with modifications of the fresh cow pen, and included enlargement of the freestalls from 45 inches (114 cm) wide to 50 inches (127 cm) and an increase from 22 inches (56 cm) feedbunk space per cow to 27 inches (69 cm).

Problems in the Generation of TCI Values

As TCI was introduced to over 5,000 dairies in Wisconsin in early 2006, a number of problems in the calculation of TCI were identified. Because TCI is based upon the first-test milk weight, any errors in first-test milk weight accuracy are amplified in the calculation. While there will always be individual cows that are incompletely milked on a given day, there are situations where milk weights are inaccurately reported and result in herd-level errors in TCI values. The two most common problems have been related to milking frequency and parlors with daily milk weights.

Accurate reporting of milking frequency becomes critical in various "AM-PM" testing schemes, where one milking is recorded and used to estimate the yield from the remainder of the day. In some dairies, milk is recorded from one of three milkings in the day, but communication errors between the dairy and the DHIA testing organization result in use of a multiplier based upon a twice-daily milking schedule, seriously underestimating the daily total and yielding extremely negative TCI values.

More difficult are herds that do not complete the milking cycles within a 24-hour period. For example, a herd may average 2.7 milkings per day, with some cows completing three milkings and others two on one day, but different populations being milked three times the next day. If the fresh cows are on a schedule like this, it becomes extremely difficult to accurately report milk per day.

Parlors with daily milk recording capabilities sometimes under-report milk yield of fresh cows. Because of the frequency of cow identification errors at an individual milking, most parlor software is programmed to report out a five or seven day average milk yield. Milk yield is expected to be increasing daily in cows in early

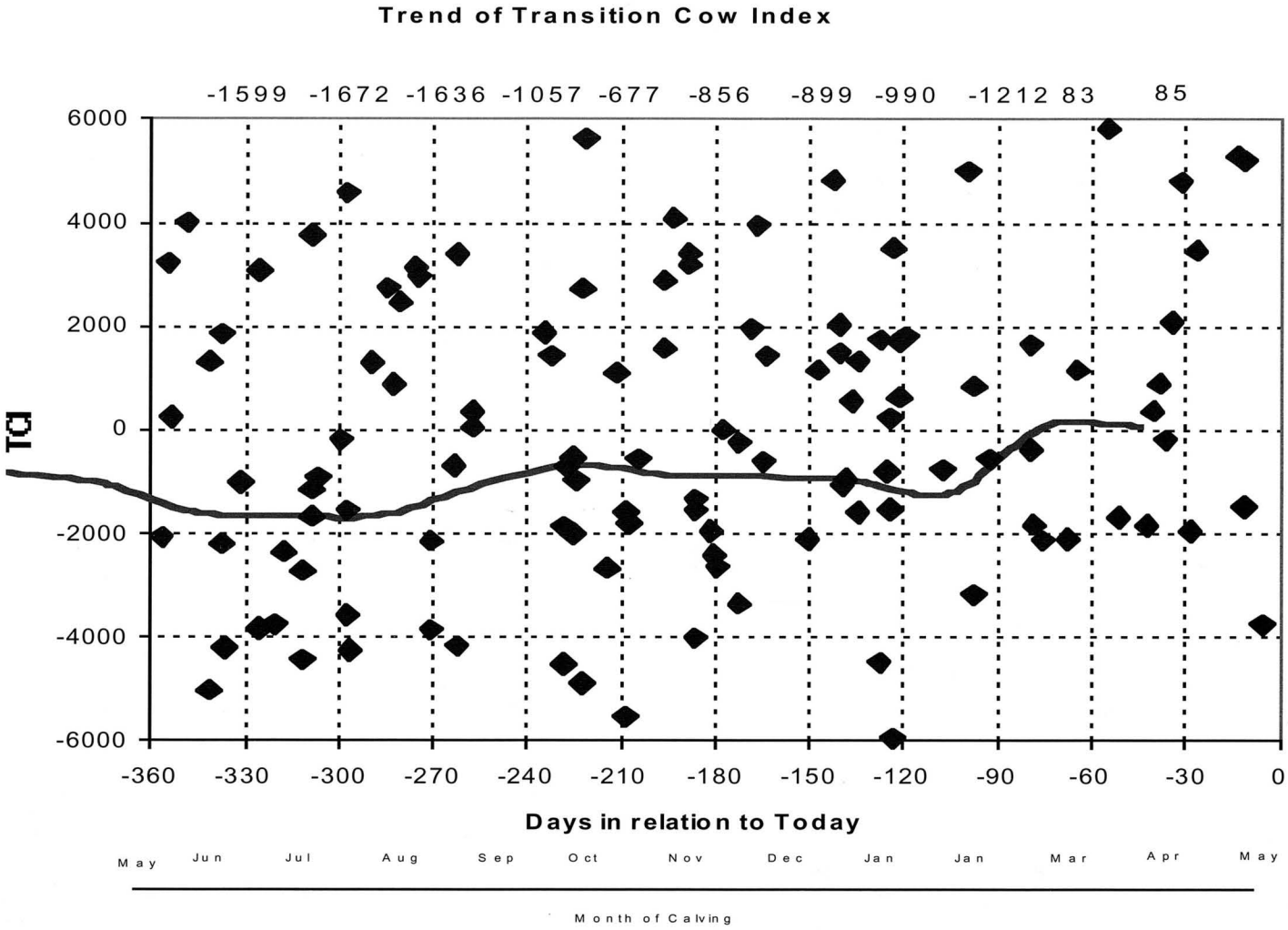

Figure 2. Transition Cow Index graph showing herd trend over the past year.

lactation. If the five or seven day average yield is reported out on the last day, that average under-represents the correct milk on the final day and results in erroneously low TCI values.

Correction of these issues results in more accurate herd TCI scores, but also improves the quality of all other milk production records.

Distribution of TCI by Milk Recording Organizations

The technology transfer agency of the University of Wisconsin, WARF,[b] has applied for a patent on TCI. WARF has licensed TCI to AgSource, the Wisconsin-based DHIA service, and will also be licensing the technology to other dairy record services. AgSource has released TCI as part of a new Fresh Cow Summary that also includes first-test fat-to-protein ratio (FPR) as a measure of risk for metabolic disorders, dry cow and heifer udder infection summary as a measurement of udder health, and the trend of cows leaving the herd in the first 60 DIM as a measure of early lactation culling. These four reports provide very objective fresh cow performance monitors to dairy herd managers and their consultants.

Endnotes

[a]Posilac, Monsanto Inc., St. Louis, MO

[b]Wisconsin Alumni Research Foundation, Madison, Wisconsin; patent applied for, TCI inventors Kenneth Nordlund, Thomas Bennett, Garrett Oetzel, Murray Clayton and Nigel Cook

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