COMPARISON OF THE TEST INTERVAL METHOD WITH BEST PREDICTION FOR ESTIMATING LACTATION YIELD

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SUMMARY

In 1969, the test interval method became the accepted procedure in the United States for estimating lactation yield from test day data. Daily yields from 658 Canadian Holsteins and information on US testing frequencies were used to determine if a best prediction method could estimate lactation yield more accurately than the currently used test interval method. For the traditional environment of near monthly tests, little difference was found between the two procedures in their accuracy of estimating actual milk produced. To determine if a change in estimation procedures is warranted, estimates from these methods should be compared for testing environments in which weights and samples are recorded at varying intervals and frequencies.

Keywords: lactation yield, test interval method, best prediction, test day data, dairy cattle.

INTRODUCTION

Historically, most cows enrolled in a milk recording program in the United States have had milk weights recorded monthly (Voelker 1981). However, practices for collecting milk and component data have been changing rapidly. Over 30 innovative test plans were introduced between 1989 and 1995. These plans differ widely in the number of milk weights recorded and the number of component samples taken. Often cows in innovative test programs are recorded less frequently than monthly, and some cows have as few as three milk component samples tested per year. For other innovative test plans, however, milk weights are recorded more frequently than before because technological development has made electronic recording feasible. Many of the newer plans have reduced labor requirements for recording milk weights and collecting samples, thus reducing cost to producers.

In 1969, the test interval method (TIM) replaced the centering date method in the United States for estimating a cow's lactation milk yield (Sargent *et al.* 1968) because TIM produces more accurate estimates than does the centering date method when milk weights and component samples are available each month (McDaniel 1969). The test interval for TIM is the period immediately following a test day through the following test day and is divided into two equal parts (Empet 1985). Production credits for the first half of the test period are based on previous test day information, and credits for the last half are based on current test day information. During the 1970s, TIM was improved to adjust first, second, and last test intervals for the nonlinear shape of the lactation

curve (Shook *et al.* 1980). These adjustments prevented biases from overestimation of first and last test credits and underestimation of second test credit.

Norman *et al.* (1985) showed that extending lactation yields to 305 days, even if a cow remained in the herd and discontinued lactation before 305 days, produced higher heritabilities and repeatabilities than if all records were not extended. This finding was the basis for crediting all cows with 305 days of yield in the US genetic evaluation system. Terminated records >240 days are not extended in the Canadian genetic evaluation system.

Recently, alternative procedures for more accurate estimation of milk and component yields using test day data have been proposed by Schaeffer and Jamrozik (1996) in Canada and by VanRaden (1997) in the United States. VanRaden's best prediction (BP) method condenses information from many test days into lactation measures of yield and persistency. The BP method requires inversion of a small matrix using correlations between individual test day information.

To determine if the BP method is more accurate than TIM for estimating yield in a wide range of testing environments, particularly for days when information is not collected, estimates from the BP method and current procedures must be compared with actual milk yield. This study compared estimates from Canadian TIM, US TIM, and BP with two measures of actual milk yield according to a traditional US testing schedule (approximately once per month).

MATERIAL AND METHODS

Individual daily milk weights and test interval yields estimated by Canadian TIM were available for 658 Canadian Holstein cows in 17 herds. Records were excluded from cows with milk weights missing for >10% of individual milkings during a lactation, and lactation lengths were required to be ≥250 days.

Measures of actual lactation yield were based either on actual yield reported up to 305 days or on actual yield extended to 305 days. Daily yields for missing days were estimated using linear interpolation if yields were reported for the day immediately before and after the missing days. If daily yield was missing for the first or last days of lactation, the missing daily yield was considered to be the same as the yield for the closest day after or before, respectively. If only one of two daily milk weights was available, daily yield was considered to be twice the single-milking weight. Based on these records that included yield estimates for days without reported milk weights, actual (≤305-day) and extended (305-day) lactation records were created by summing all daily yields.

Test interval frequencies of traditional US test plans were determined based on actual days in milk reported for test days of 96,102 US cows. To compare accuracy of estimation by TIM (Canadian and US) and BP, individual daily yields of the 658 Canadian cows were selected to correspond to test intervals of the 96,102 US cows. Although certain individual daily yields were used several times in characterizing the US test interval frequencies, only a small fraction of the possible daily yield pairs were expected to be repeated, and many of the possible pairs were not expected to be

included at all. Lactation yields ≤305 days were estimated using Canadian TIM; 305-day yields were estimated using US TIM and BP.

RESULTS AND DISCUSSION

Means and standard deviations for actual and estimated yields are in Table 1. Means for both US TIM and BP were highest because all records were extended with these estimation methods but their means still were similar to the mean for actual 305-day yield. Standard deviation was lower for US TIM than for Canadian TIM, probably because of less influence from lactation length. Standard deviation was lowest for BP, which regresses outlier test yields.

Table 1. Means and standard deviations for actual lactation yields (≤305-day and 305-day) and corresponding yields estimated by Canadian TIM, US TIM, and BP

Lactation yield	Estimation method	Mean (kg)	Standard deviation (kg)
≤305-day			
Actual	. . .	8301	1555
Estimated	Canadian TIM	8515	1577
305-day			
Actual	. . .	8664	1539
Estimated	US TIM	8700	1545
	BP	8690	1435

Correlations between actual and estimated yields are in Table 2. Correlations between actual and estimated yield within country were high (.98 for Canada and .97 for the United States). The correlation between yield estimates from US TIM and BP was extremely high (.997), which indicates that these methods are equivalently accurate for estimating 305-day yield in a traditional US testing environment.

Table 2. Correlations between actual lactation yields, lactation yields estimated by Canadian TIM, actual 305-day yields, and 305-day yields estimated by US TIM and BP

	≤305-day yield		305-day yield		
Lactation yield	Actual	Canadian TIM	Actual	US TIM	BP
≤305-day					
Actual	1.00	.98	.98	.96	.96
Canadian TIM		1.00	.97	.95	.95
305-day					
Actual			1.00	.97	.97
US TIM				1.00	1.00
BP					1.00

Standard deviations of differences between estimated and actual yields are in Table 3. Standard deviations of differences between actual 305-day yield and estimates from US TIM and BP were nearly the same, which again indicates that these procedures provide similar estimates in a near-monthly testing environment. Standard deviations of difference from actual yield were lower for Canadian TIM than for US TIM regardless of lactation length for actual yield.

Table 3. Standard deviations of differences between actual (≤305-day and 305-day) and estimated (Canadian TIM, US TIM, and BP) yields

	Standard deviation (kg) of difference from actual lactation yield		
Actual lactation yield	Canadian TIM ≤305-day estimate	US TIM 305-day estimate	BP 305-day estimate
≤305-day	326	451	451
305-day	367	387	388

As expected, comparisons between BP and US TIM for a traditional US testing environment indicate that these methods produce equivalent estimates of lactation yield. To determine if a change in estimation procedures is warranted, estimates from these methods will be compared for testing environments in which weights and samples are recorded at varying intervals and frequencies.

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