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Duration of Herd Participation in Dairy Herd Improvement Milk Recording in the United States

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ABSTRACT

Participation in milk-recording programs that provide data for national genetic evaluations of dairy cattle in the United States is voluntary, but the effectiveness of the evaluation system increases with the number of herds that contribute data. To investigate patterns of herd participation in Dairy Herd Improvement (DHI) testing, periods of continuous testing were computed based on the year that a herd initiated or terminated testing and by geographical region. Continuous testing was defined as at least one test per 6-mo period. Some herds discontinued testing and then re-enrolled. Across all years (1960 through 2002), 65% of herds had one period of continuous testing (no testing lapse). The percentage of herds with testing lapses decreased as the number of lapses increased and as the initial test year became more recent; overall, only 1.5% of herds had more than 6 continuous testing periods. For herds that terminated DHI testing from 1960 through 2002, 64% were on continuous test for <3 yr. In general, herd frequencies decreased as continuous test period increased except for continuous testing of ≥20 yr, which increased to 13% for years 2000 to 2002. Herds with more recent termination dates had remained on continuous test longer, and one-third of herds that were still on test after June 2002 had been on test for at least 20 yr. The duration of herd participation was longest for the northeastern and mideastern United States and shortest for the southeastern United States. Multiple periods of testing with lapses of >6 mo between test periods represent a loss of data that could have enhanced the study and evaluation of genetic characteristics of US dairy cattle.
(**Key words:** Dairy Herd Improvement, milk recording, herd participation)

INTRODUCTION

Milk recording was initiated in the United States in 1906 (Voelker, 1981). Lactation records were calculated by hand for nearly half a century until 1950, when Crandall and Rich pioneered data processing of Dairy Herd Improvement (DHI) records using IBM punch-card equipment at Utah State University (DHI Computing Service, 2003). By 1960, most DHI record calculations were converted to automated processing.

National and international genetic evaluation systems rely on the participation of producers for herd management data. Estimates of genetic parameters and breeding values are more accurate when based on large numbers of observations, and animal models used for genetic evaluation are enhanced when data are available for many relatives. An effective milk-recording program is a basic requirement for any organization that wants to operate a successful progeny-test program. The number of young bulls that can be tested is directly related to the available dairy cattle population and the extent of its participation in production testing. The percentage of US cows enrolled in DHI programs is reported each year by the USDA's Animal Improvement Programs Laboratory (2003). This percentage has varied from 45 to 48% during the last 9 yr. The International Committee for Animal Recording (2002) annually reports on the situation of milk recording for its member countries. For the 25 countries that participated in international genetic evaluations for production traits during 2000 (International Bull Evaluation Service, 2001), percentages of cows that were milk-recorded ranged from 2% for Poland to 90% for Denmark (International Committee for Animal Recording, 2002).

In the United States, producer participation in milk-recording programs is voluntary, and nearly all the cost is borne by the producer. Although new herds enroll in DHI testing, participating herds may discontinue testing either permanently or temporarily. The extent of participation is influenced by the perceived benefit of the information provided to the producer, the cost of obtaining such information, and likely the robustness of the dairy economy across time.

To date, little information has been available about how long herds remain enrolled in DHI programs. Knowing definitively if or when a herd discontinues testing is a challenge. More producers are taking ad-

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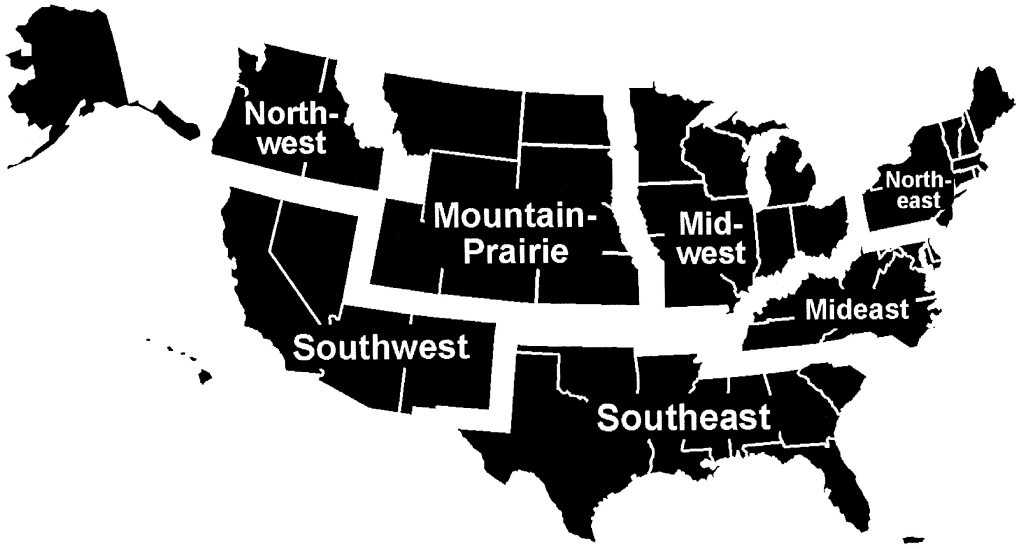

Figure 1. Definition of US regions (Mideast = Delaware, Kentucky, Maryland, North Carolina, Tennessee, Virginia, and West Virginia; Midwest = Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin; Mountain-Prairie = Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, Utah, and Wyoming; Northeast = Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; Northwest = Alaska, Idaho, Oregon, and Washington; Southeast = Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, Puerto Rico, South Carolina, and Texas; and Southwest = Arizona, California, Hawaii, Nevada, and New Mexico).

vantage of innovative testing opportunities that provide more flexibility in designing testing schedules. In addition, the use of seasonal calving has become more frequent, and more herds have extended periods when no cows are milked. This summary of herd participation since 1960 was compiled to assist DHI organizations and others in providing management services that meet the needs of dairy producers.

MATERIALS AND METHODS

Data available on calving date and lactation length from the national dairy database at the Animal Improvement Programs Laboratory, USDA (Beltsville, MD) were used to define the year and month that each herd initiated and discontinued DHI milk recording through December 2002. As long as the interval between milk weights for the herd never exceeded 6 mo, the herd was assumed to have continued DHI participation. When data on calving dates and milk weights ceased for >6 mo, the herd was assumed to have terminated its enrollment in the DHI management program as of the last test date. This termination sometimes resulted from discontinuation of the dairy operation. The possible lapse period of 6 mo was

Table 1. Frequency, means, and SD for periods of continuous Dairy Herd Improvement test for herds by year of initial test.

	Periods of continuous test[1]						
Initial test year	1	2	3	4	5 and 6	>6	Mean ± SD
	(%)						(yr)
<1960	20.2	20.3	17.6	14.6	17.2	10.2	3.5 ± 2.3
1960 to 1964	57.5	20.2	10.2	4.9	4.5	2.7	2.0 ± 1.7
1965 to 1969	59.9	19.1	9.1	4.8	3.9	3.2	1.9 ± 1.8
1970 to 1974	62.6	19.6	8.1	4.0	3.4	2.2	1.8 ± 1.5
1975 to 1979	62.2	20.4	8.7	3.9	3.1	1.6	1.8 ± 1.4
1980 to 1984	65.5	20.2	7.4	3.4	2.3	1.2	1.6 ± 1.3
1985 to 1989	69.5	18.0	6.4	2.8	2.4	1.0	1.6 ± 1.2
1990 to 1994	69.2	17.7	6.9	3.1	2.5	0.7	1.6 ± 1.1
1995 to 1999	72.9	16.3	6.0	2.9	1.7	0.1	1.5 ± 0.9
2000 to 2002	83.7	13.0	3.0	0.4	0.0	0.0	1.2 ± 0.5
1960 to 2002	64.8	19.0	7.9	3.7	3.0	1.6	1.7 ± 1.4

[1]Period of continuous test had no interval between herd milk weights of >6 mo; multiple periods of continuous test had testing lapses of >6 mo.

Table 2. Numbers and percentages of Dairy Herd Improvement (DHI) herds by duration of testing lapse for herds that discontinued and then re-enrolled in DHI testing.

Testing lapse	Number	Percentage
6 mo to <1 yr	157,036	70.8
1 to <3 yr	49,685	22.4
3 to <5 yr	6961	3.1
5 to <10 yr	5294	2.4
≥10 yr	2991	1.4

chosen to ensure that herds with uncommon management programs, such as seasonal calving, were included in the study.

In some cases, a herd that had milk weights discontinued for >6 mo began to have weights reported again. In such cases, the herd was assumed to have been re-enrolled in DHI testing. Herds with multiple periods of continuous test (i.e., one or more testing lapses of >6 mo) were counted as separate herds for each continuous testing period. The frequency and length of testing lapses were examined.

The duration of herd participation in DHI was measured as the interval in years and months between initiation and termination of DHI testing. Nine duration intervals were defined: 1) 1 mo, 2) 2 to <4 mo, 3) 4 mo to <1 yr, 4) 1 to <3 yr, 5) 3 to <5 yr, 6) 5 to <10 yr, 7) 10 to <15 yr, 8) 15 to <20 yr, and 9) ≥20 yr. Herds that were on test for only 1 mo included herds with only one reported milk weight and thus were assumed not to have continued in the program. Herds that initiated testing in recent years did not have time to qualify for many of the longer duration intervals. To determine if testing practices varied by region, the 50 states plus Puerto Rico were divided into 7 geographical regions: Mideast, Midwest, Mountain-Prairie, Northeast, Northwest, Southeast, and Southwest (Figure 1).

Frequency of continuous testing and testing lapses were documented by year, testing duration, and region. Means and standard deviations of continuous testing over time were calculated by year and region.

The relationship between economic conditions and DHI testing participation were examined as suggested by a reviewer. Models containing milk:feed price ratio (D. Kenerson, National Agricultural Statistics Service, personal communication), year, month, and counts for herds going on or off test from 1984 to 2002 were used. Models that did not include month were used as well.

RESULTS AND DISCUSSION

The frequency of periods of continuous testing (Table 1) indicates DHI testing practices over time. About 65% of herds from 1960 through 2002 had a single period of continuous testing and thus no testing lapse. The percentages of herds from 1960 through 2002 with 2, 3, or 4 periods of continuous testing were 19, 8, and 4%, respectively, and 5% of herds had 5 or more periods of continuous testing; only 1.6% of herds had more than 6 testing periods. Not surprisingly, the percentage of herds with more testing lapses was greater for herds that began participation in DHI testing during the early years. If data for the same years of initiation were re-examined in the future, the percentage of herds without a testing lapse would likely decrease and the percentages of herds in all other categories would increase, especially for more recent years. This shifting of percentages is expected because the longer a herd is enrolled in DHI testing, the greater the opportunity for a period of inactivity.

Most (71%) of the herds with a testing lapse had an inactive period of <1 yr (Table 2). Only 7% of herds had testing lapses of >3 yr. Whether or how often a discontinued herd code was assigned to a different herd was not examined because of the computational difficulty. When ownership of an operation is changed, the same herd code can be retained.

Table 3. Frequency of herds by time on continuous Dairy Herd Improvement test and year of initial test.

Initial test year	1 mo	2 to 3 mo	4 to 11 mo	1 to 2 yr	3 to 4 yr	5 to 9 yr	10 to 14 yr	15 to 19 yr	≥20 yr
	(%)								
1960 to 1964	19.9	17.8	16.3	16.1	8.1	10.1	4.0	1.8	6.0
1965 to 1969	18.2	16.5	15.9	16.6	7.9	9.7	3.8	2.8	8.6
1970 to 1974	19.5	15.9	15.7	14.9	7.1	8.1	5.3	3.4	10.0
1975 to 1979	19.9	14.4	14.0	13.3	6.7	11.0	5.7	4.5	10.3
1980 to 1984	19.6	14.6	14.8	15.9	7.9	9.4	5.9	...[1]	...[1]
1985 to 1989	21.2	13.6	14.2	14.9	7.6	11.9	...[1]	...[1]	...[1]
1990 to 1994	23.1	14.0	14.9	16.6	8.5	...[1]	...[1]	...[1]	...[1]
1995 to 1999	21.2	13.0	15.0	16.0	...[1]	...[1]	...[1]	...[1]	...[1]
2000 to 2002	27.8	15.3	...[1]	...[1]	...[1]	...[1]	...[1]	...[1]	...[1]
All years	20.3	15.3	...[1]	...[1]	...[1]	...[1]	...[1]	...[1]	...[1]

[1]Insufficient time had elapsed to make calculation useful.

Table 4. Frequency of herds by time on continuous Dairy Herd Improvement test and year of termination of participation.

Termination year	1 mo	2 to 3 mo	4 to 11 mo	1 to 2 yr	3 to 4 yr	5 to 9 yr	10 to 14 yr	15 to 19 yr	≥20 yr
	(%)								
1960 to 1964	22.3	20.2	19.1	19.4	8.7	8.5	1.7	0.0	0.0
1965 to 1969	17.9	16.2	16.3	19.1	10.8	14.3	4.2	1.1	0.0
1970 to 1974	19.3	15.8	15.4	16.2	8.8	14.6	6.9	2.3	0.6
1975 to 1979	24.0	17.2	16.6	14.9	7.0	9.4	6.1	3.2	1.6
1980 to 1984	23.2	17.3	17.5	17.3	7.9	8.5	3.6	2.6	2.1
1985 to 1989	19.6	12.8	13.6	16.1	9.0	13.3	6.2	3.5	5.8
1990 to 1994	19.7	11.9	13.0	15.1	8.1	12.6	7.9	4.4	7.3
1995 to 1999	18.6	11.6	13.2	14.8	6.4	10.9	7.8	6.4	10.2
2000 to 2002	18.4	9.9	12.1	12.4	12.2	9.0	6.9	5.6	13.4
All years	19.0	14.4	14.8	15.9	8.5	12.1	5.8	3.5	6.1
Herds still on test	2.5	2.4	4.3	7.4	6.9	20.5	11.9	11.0	33.2

During the period of 1960 to 2002, approximately 20% (18 to 28%) of the herds were tested only once and did not participate further (Table 3). Those herds may have included those for which the producer accepted a free test as a recruiting promotion but then decided not to continue testing when payment for the service was required. Another 13 to 18% and 14 to 16% of the herds tested for only 2 to 3 mo and 4 to 11 mo, respectively. The percentage of herds remaining on test for 15 to 19 yr increased from 2% for 1960 through 1964 to 4% for 1975 through 1979. During the same periods, the percentage of herds remaining on test for >20 yr increased from 6 to 10%. Percentages for longer duration intervals are not reported for herds that began DHI testing in more recent years because of insufficient time for herds to complete these longer intervals.

To provide information about longer periods of participation for recent years, the duration of DHI participation for herds that had terminated testing was examined (Table 4). For herds that terminated DHI testing from 1960 through 2002, 64% were on continuous test for <3 yr. In general, frequencies for each duration interval were similar to those in Table 3. For example, 19% of herds were tested only once, and 14 and 15% were on test for only 2 to 3 mo and 4 to 11 mo, respectively. Those findings validate the trend that herds are staying on DHI test longer in recent years (Table 3). In general, herd frequencies decreased as continuous test period increased except for herds that terminated DHI participation during recent years after continuous testing of ≥20 yr. For termination years after 1984, herd participation for ≥20 yr of continuous testing (6 to 13%) was higher than for 15 to 19 yr of testing (4 to 6%). Herds with more recent termination dates had remained on continuous test longer. For herds that remained on DHI testing (those with tests after June 2002), 77% had been enrolled for >5 yr and one-third had been on test for at least 20 yr.

For herds that terminated DHI testing recently (1995 through 2002), those in the Mideast and Northeast (Table 5) had the lowest percentages of herds with only a single test and also had the highest percentage of herds on continuous test for >20 yr. In contrast, the Southeast, Southwest, and Midwest had the highest percentage of herds with a single test and the lowest percentage on continuous test for >20 yr.

Means for numbers of years that herds were on continuous DHI test (Table 6) increased across time for all regions except for small declines between 1974 and

Table 5. Frequency of herds by time on continuous Dairy Herd Improvement test and means and SD of time on continuous test by region for herds that terminated participation during 1995 through 2002.

Region	Time on test									Mean ± SD
	1 mo	2 to 3 mo	4 to 11 mo	1 to 2 yr	3 to 4 yr	5 to 9 yr	10 to 14 yr	15 to 19 yr	≥20 yr	
	(%)									(yr)
Mideast	14.4	10.0	12.5	13.0	7.6	12.6	8.3	6.4	15.7	8.3 ± 10.8
Midwest	20.0	11.7	13.4	14.2	8.1	9.5	7.1	6.0	10.2	6.2 ± 9.4
Mountain-Prairie	18.4	9.2	12.3	13.6	7.7	13.0	8.8	5.6	11.3	6.6 ± 8.9
Northeast	15.5	10.4	11.7	14.4	8.7	10.8	8.1	7.1	13.4	7.7 ± 10.5
Northwest	17.0	9.4	13.3	14.0	8.2	10.9	9.0	6.4	11.9	7.0 ± 9.4
Southeast	21.9	11.4	15.1	14.4	6.6	11.7	7.4	4.5	7.0	5.1 ± 7.8
Southwest	20.8	11.0	11.6	12.8	10.1	11.1	6.9	5.8	9.9	5.9 ± 8.2
United States	18.6	11.1	12.9	14.1	8.1	10.4	7.6	6.2	11.2	6.7 ± 9.6

Table 6. Means and SD of time that herds remained on continuous Dairy Herd Improvement test by region and year of termination of herd participation.

Termination year	Northeast	Mideast	Southeast	Midwest	Mountain-Prairie	Northwest	Southwest	United States
	(%)							
1960 to 1964	2.0 ± 2.7	1.5 ± 2.3	1.1 ± 1.9	1.5 ± 2.4	1.2 ± 2.0	1.5 ± 2.4	1.8 ± 3.0	1.6 ± 2.5
1965 to 1969	3.7 ± 4.1	2.2 ± 3.2	1.6 ± 2.6	2.2 ± 3.2	1.8 ± 2.7	2.2 ± 3.0	1.7 ± 2.8	2.6 ± 3.5
1970 to 1974	4.6 ± 5.3	3.1 ± 4.4	2.6 ± 3.9	2.9 ± 4.2	2.7 ± 3.7	2.8 ± 3.9	1.7 ± 2.7	3.2 ± 4.4
1975 to 1979	3.6 ± 5.8	3.3 ± 5.3	2.5 ± 4.4	2.9 ± 5.0	2.7 ± 4.0	2.4 ± 3.8	2.3 ± 3.5	3.0 ± 5.0
1980 to 1984	3.4 ± 5.8	3.4 ± 5.6	1.9 ± 3.6	2.5 ± 4.8	2.7 ± 4.7	2.2 ± 3.8	2.4 ± 3.6	2.8 ± 5.0
1985 to 1989	5.9 ± 8.0	5.5 ± 7.9	3.1 ± 5.2	3.9 ± 6.4	4.2 ± 6.2	4.2 ± 5.8	4.5 ± 5.6	4.6 ± 6.9
1990 to 1994	6.2 ± 8.6	6.3 ± 9.0	3.4 ± 6.1	5.1 ± 7.8	4.6 ± 6.9	5.6 ± 7.4	4.8 ± 6.5	5.3 ± 7.9
1995 to 1999	7.6 ± 10.2	8.1 ± 10.4	4.9 ± 7.5	6.0 ± 9.1	6.5 ± 8.7	6.8 ± 9.0	5.6 ± 7.8	6.5 ± 9.4
2000 to 2002	8.2 ± 11.3	8.9 ± 11.8	5.7 ± 8.8	6.8 ± 9.8	7.0 ± 9.1	7.5 ± 10.4	6.4 ± 9.0	7.2 ± 10.2
All years	2.9 ± 5.7	2.7 ± 5.5	2.4 ± 4.7	2.6 ± 5.3	2.3 ± 4.7	2.0 ± 4.0	3.1 ± 5.2	2.6 ± 5.3

1984 in 5 regions. Declines in standard deviations (Table 6) were less frequent for those same regions and years. Increases in means and standard deviations over time are not surprising because the opportunity to enroll in computerized DHI testing was not available until the mid to late 1950s. Herds that recently discontinued testing had been enrolled for a mean of 7 yr, with an SD of 10 yr.

The duration of herd participation in DHI testing varies considerably by region. Since 1980, participation was shorter than the US mean for herds in the Southeast, Midwest, and Southwest. Herds in the Northeast had the longest time on test before 1990, but they have since fallen behind the Mideast. From 1995 through 2002, herds in the Northeast and Mideast remained on test the longest (7.8 and 8.3 yr, respectively); the shortest time on test (5.1 yr) occurred in the Southeast.

To examine the possible role of economic conditions in producers' decisions to begin or terminate their participation in testing, linear models with effects of year, month, and milk/feed price ratio were fitted. Models that examined the effects of years or months individually were also examined. Because the decision might be delayed from the actual month of the price change, the mean of the previous 3 mo milk:feed price ratios were also investigated. However, there was no significant relationship between milk:feed price ratio and the number of herds initiating or terminating testing. This is unexpected because the cost of participation would seem to be a major factor in decisions about participation. It is possible that a clearer relationship would be seen with more data; unfortunately, price information was only available beginning in 1984.

CONCLUSIONS

The duration of herd participation in DHI testing varied geographically and tended to increase over time from 1960 through 2002. Herds in the Northeast and Mideast tended to remain on test longest during recent years; the shortest time on test occurred in the Southeast. Many herds entered and exited the DHI program multiple times, which caused lapses of data that could have increased the accuracy of information available for management and enhanced understanding of the genetic characteristics of the US dairy population. Even among herds that began testing from 2000 through 2002, 16% had at least one testing lapse of >6 mo. Some of those lapses may have resulted from financial difficulties that caused a producer to reduce operational expenses by temporarily discontinuing DHI participation. Short disruptions in DHI service to local areas may also have contributed to data lapses. Further research to discover the causes of data lapses could aid in improving DHI management services and thus attract more participants, improve producer benefits, and increase data available for calculation of genetic evaluations.

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