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H. L. Barr
Ohio State University

H. W. Carter
Cornell University

L. Dale Van Vleck
University of Nebraska-Lincoln, dvan-vleck1@unl.edu

Effects of Age, Herd, and Herd Status on Classification Scores of Jersey Cattle

H. L. BARR
Department of Dairy Science
The Ohio State University, Columbus 43210
and
H. W. CARTER and L. D. VAN VLECK
Department of Animal Science
Cornell University, Ithaca, New York 14850

Abstract

Classification was arranged for herds belonging to the official Jersey program concurrently with classification for Jersey research herds. Herds were categorized as official, registered research and grade research. Cattle were also grouped as 2 year olds, 3 to 4 year olds and 5 year olds.

Differences for herd status were significant ($P < .05$) for all type traits except stature, breed character, feet and legs and fore udder. Research cattle scored higher only in dairy character and udder quality. Differences between registered research and grade research cattle were not significant.

Differences for age were significant for all traits except feet and legs, mammary and rear udder. Five year-olds scored highest in final score, general appearance, stature, breed character, back and rump, and chest and barrel. The traits relating to mammary system were scored higher on younger cows.

For final score, herds accounted for 9.6 and sires 10.1% of the variance. Heritabilities ranged from .19 for feet and legs to .68 for stature.

Indexes comparing sires' daughters to contemporaries had correlations below .90 with other indexes. Adjusting for number of daughters did not greatly alter correlations.

Introduction

Type continues to interest many people reproducing dairy cattle. Attempts at developing critical methods of evaluating sires for type transmission have been made, but information supporting such methods is far from complete. Some breed associations take into account age differences in adjusting final score, but adjustment has not been generally used in evaluating component type traits. Also the relative performance of sires in herds whose owners have limited interest in the classification program has not been studied. In addition nonregistered offspring of sires have not been thoroughly examined. The purposes of this study were a) to compare the evaluation of animals in different types of herds, b) to determine age effects on final score and components of type, and c) to compare sire values developed from daughter averages deviated from various bases.

Experimental Procedures

A joint project was arranged by the American Jersey Cattle Club and Eastern Artificial Insemination Cooperative, Inc., to classify cattle experimentally in Northeastern United States.

In addition to the herds for which owners had requested classification as a part of the official Jersey program, a group of research herds were selected for classification. The research herds had both registered and grade Jerseys under ownership which had not expressed interest in classification before this tour. There were 51 official herds and 37 research herds. Two classifiers of the American Jersey Cattle Club completed the entire classification project in 3 months. Cattle were categorized for herd status as official, registered research and grade research.

The numerical final score for each animal was assigned by the classifier on a scale of 1 to 100. The traits included in components of final score were assigned ratings by the classifier of Excellent, Very Good, Desirable, Acceptable and Poor and were coded, 5, 4, 3, 2, 1.

Animals were grouped by ages as less than 1,098 days (2 year olds), 1,098 to 1,829 days (3 and 4 year olds) and over 1,829 days of age (5 year olds) at classification.

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Results and Discussion

The average of final type scores of all cows in the project was 81.9 with a standard deviation of 3.4. In Table 1 are listed the average final scores for animals within each age by herd status. The numbers in each subgroup are in parentheses in Table 1. The significance of age and herd status differences were tested by an analysis of variance of unweighted means as described by Van Vleck (15) for a 2-way fixed classification model of age and herd status.

The average performance for final score in official herds exceeded the 2 research groups ($P < .01$). The only difference within age of significance at 5% was between official and registered research for 5 year olds. Age differences were significant at 1%. From this table the proportion of young cows in official herds is relatively high. The ratios of 2 year olds to the 2 older age groups in official, registered research and grade research were approximately 1:3, 1:4 and 1:5.

The component type scores by age are in Table 2 along with F values. Age had a significant effect on all categories except feet and legs, mammary score and rear udder. Older cows scored higher in general appearance, stature, breed character, back and rump, dairy character, and chest and barrel. Younger cows were higher in fore udder, teats, suspensory ligament and udder quality. In general young cows were slightly higher or equal in categories that might be construed as contributing to lasting ability of cows (feet and legs, mammary, rear udder, fore udder, suspensory ligament and quality of udder). Within this population, sires with a preponderance of 2 year old daughters would be at a disadvantage for total score, general appearance, stature, breed character, back and rump, dairy character, and chest and barrel. These results have a pattern similar to work by Wilcox et al. (16) with Holstein cattle. They reported that scores of traits increased with age, except that feet and legs and fore udders changed little through the first 5 lactations. Hansen et al. (4) found a significant increase with age for final score and the 4 major categories in Holsteins. Hyatt et al. (7) reported higher ratings on groups of cows with greater age, but when the same cows at various ages were studied, only the difference between the 4 and 5 year olds was significant.

As presented in Table 3, significant herd status effects existed for all categories except stature, breed character, feet and legs, and fore udder. Research cows exceeded official cows in dairy character and udder quality but official cattle scored higher in all other traits where differences existed. Although the herd status effects were significant for most traits, the magnitude of the differences indicates that it is of less concern in evaluating sires than is the age of daughters.

In a separate analysis herd effects as contrasted with herd status were investigated with only daughters of artificial insemination sires as they were used across herds. The components of variance for age, herd, sire, and sire by herd interaction effects in this population are presented in Table 4. In the analysis by Henderson's Method One (6) all effects were assumed to be random and uncorrelated. There were 102 sires and 1,861 daughters in 88 herds in this analysis. Herd components of variance for traits ranged from 5 to 11 with 9.6% for final score. The component of variance for sire exceeded the component of variance for herd for all traits except feet and legs. Age contributed 14.7% of the variance in chest and barrel, and this was twice the contribution of herd. For the traits dairy character and breed character, age contributed 9.8 and 9.0% of the variance, and this again was approximately twice the herd contribution. By contrast, age contributed little to variance in feet and legs, mammary, fore udder, rear udder and teats.

Heritability estimates are in Table 4 and were computed from the sire components of variance by the following formula:

$$\text{Heritability} = 4\sigma^2_s/(\sigma^2_s + \sigma^2_{hs} + \sigma^2_e)$$

TABLE 1. Comparison of averages of final scores by age and by herd status.

	2 Year Old	3-4 Year Old	5 Year Old	Average
Official	81.0 (540)[a]	81.7 (889)	83.2 (631)	82.0 (2,060)
Registered research	80.4 (215)	81.2 (416)	82.6 (475)	81.6 (1,106)
Grade research	80.4 (66)	81.5 (152)	82.6 (212)	81.9 (430)
Averages	80.8 (821)	81.5 (1,457)	82.9 (1,318)	81.9 (3,596)

F value for age = 71., F value for herd status = 6, $P<.01$ for both.
[a] Number of animals

TABLE 2. Average scores of components by age.

	Gener. app.	Stature	Breed char.	Back Rump	Feet Legs	Dairy char.	Chest Brl.	Mammary	Fore udder	Rear udder	Teats	Ligament	Quality
2 Year (821)[a]	2.80	3.08	2.79	2.78	2.96	3.58	3.43	2.95	2.94	2.89	3.07	3.06	3.83
3-4 Year (1,457)	3.00	3.44	2.90	3.10	2.86	3.73	3.85	2.92	2.85	2.92	2.98	3.41	3.65
5 Year (1,318)	3.22	3.66	3.26	3.16	2.93	4.18	4.17	2.88	2.82	2.89	2.94	3.14	3.56
F value	62.**	82.**	50.**	61.**	1.	78.**	173.**	2.	8.**	.2	6.*	47.**	21.**
Averages	3.04	3.44	3.01	3.05	2.91	3.86	3.87	2.91	2.86	2.90	2.99	3.36	3.66

* $P<.05$
** $P<.01$
[a] Number of animals

TABLE 3. Average scores of components by herd status.

	Gener. app.	Stature	Breed char.	Back Rump	Feet Legs	Dairy char.	Chest Brl.	Mammary	Fore udder	Rear udder	Teats	Ligament	Quality
Official (2,060)[a]	3.07	3.46	3.02	3.15	2.91	3.85	3.91	2.97	2.89	2.97	3.05	3.38	3.62
Registered research (1,106)	2.99	3.37	2.98	2.91	2.90	3.83	3.83	2.82	2.81	2.81	2.93	3.26	3.64
Grade research (430)	3.03	3.54	3.04	2.93	2.91	4.02	3.81	2.87	2.84	2.84	2.84	3.49	3.88
F value	6.**	4.	3.	25.**	1.	5.*	15.**	5.**	3.	6.**	6.**	14.**	20.**
Averages	3.04	3.44	3.01	3.05	2.91	3.86	3.87	2.91	2.86	2.90	2.99	3.36	3.66

* $<.05$
** $<.01$
[a] Number of animals

TABLE 4. Percentage of total variance contributed by age, sire, herd, and herd by sire interaction and heritabilities.

	Age	Sire	Herd	H × S	Error	Heritability
Total score	6.7	10.1	9.6	3.4	70.2	.48
General appearance	5.7	11.2	8.8	3.9	70.4	.53
Stature	6.9	14.0	10.5	0.8	67.7	.68
Breed character	9.0	8.4	5.1	6.6	70.9	.39
Back, Rump, Tail	4.5	11.6	10.7	1.5	71.7	.55
Feet, Legs	0.3	4.4	5.0	6.6	83.7	.19
Dairy character	9.8	12.5	5.5	5.1	67.0	.59
Chest, Barrel	14.7	8.7	8.2	2.4	66.0	.45
Mammary	0.2	7.4	6.0	2.9	83.4	.32
Fore udder	0.7	6.9	5.3	4.7	82.4	.29
Rear udder	0.0	9.2	7.6	0.0	83.5	.40
Teats	0.1	8.6	5.6	0.7	84.9	.37
Suspensory ligament	6.7	7.7	7.7	0.0	79.7	.36
Quality	3.4	11.8	11.0	1.0	72.7	.55

Where

σ^2_s = sire component of variance
σ^2_{hs} = herd by sire interaction variance
σ^2_e = error component of variance

The heritability for final score was .48 and ranged from .19 for feet and legs to .68 for stature. These heritabilities within age and herd were high compared with not only previous studies of Jersey cattle (5, 9) but with values reported in other breeds (1–4, 8, 11–13). Heritabilities in other studies have ranged from .14 to .37 for total score.

A third analysis involved methods of comparing daughter means to compensate for age and herd effects and number of daughters. This was explored by computing daughter average deviations from herdmates (animals in the same herd), contemporaries (animals in the same herd and in the same age category), herdmates adjusted for numbers, and contemporaries adjusted for numbers. Additional indexes were derived by comparing the daughter average with the population mean, herdmates, contemporaries, adjusted herdmates, and adjusted contemporaries, and adjusting these deviations for number of daughters. The formulation of each index follows:

Index I. Daughter mean = $\Sigma D/Nd$

Index II. Average daughter deviation from herdmates = $\Sigma[D - Hm]/Nd$

Index III. Average daughter deviation from contemporaries = $\Sigma[D - Cn]/Nd$

Index IV. Average daughter deviation from adjusted herdmates = $\Sigma[D - (Hm - M)Nhm/(Nhm + 10) + M]/Nd$

Index V. Average daughter deviation from adjusted contemporaries = $\Sigma[D - (Cn - Am)Ncn/(Ncn + 10) + Am]/Nd$

Index VI. Average daughter deviation from population-mean adjusted for number of daughter =
$[\text{Index I} - M] \times Nd/(Nd + 20)$

Indexes VII through X. Identical with Indexes II to V except that Indexes VII to X were adjusted for number of daughters by the same factor used in Index VI.

Where

D = daughter score,
Nd = number of daughters,
Hm = average score of herdmates,
Cn = average score of contemporaries,
M = population mean score,
Nhm = number of herdmates,
Ncn = number of contemporaries, and
Am = population mean of appropriate age group.

The regression for herdmate and contemporary numbers, $Nhm/(Nhm + 10)$, and the adjustment for daughter numbers, $Nd/(Nd + 20)$, were from data by Van Vleck (14), Carter et al. (2), Specht et al. (10) and from Table 4 of this paper.

The correlations between daughter means (Index I) and the 9 indexes for each type component are in Table 5. Deviating the scores of the daughters from population mean and adjusting for number of daughters (Index VI) produced correlations above .92 for all components of type with daughter average. Deviating daughters from adjusted herdmates (In-

TABLE 5. Correlations between daughter mean (Index I) and 9 other type indexes for sires.

Index	Final score	Gener. app.	Stature	Breed char.	Back Rump	Feet Legs	Dairy char.	Chest Brl.	Mammary	Fore udder	Rear udder	Teats	Ligament	Quality
II	.810	.851	.834	.891	.824	.885	.866	.819	.834	.866	.842	.855	.811	.758
III	.697	.731	.748	.804	.773	.803	.776	.655	.763	.830	.749	.827	.690	.658
IV	.899	.928	.910	.930	.903	.933	.917	.878	.902	.930	.905	.919	.895	.876
V	.881	.899	.887	.889	.916	.944	.880	.779	.926	.948	.922	.939	.862	.888
VI	.936	.932	.932	.930	.928	.933	.933	.917	.937	.936	.937	.932	.939	.934
VII	.772	.813	.791	.838	.795	.840	.817	.755	.779	.827	.792	.799	.756	.689
VIII	.680	.719	.729	.762	.753	.763	.739	.622	.725	.805	.723	.771	.655	.621
IX	.841	.867	.847	.869	.852	.878	.857	.800	.844	.785	.848	.855	.833	.795
X	.839	.851	.838	.847	.872	.887	.829	.733	.874	.897	.871	.877	.813	.828

TABLE 6. Correlations between adjusted daughter deviation from contemporaries (Index VIII) and 9 other indexes.

Index	Final score	Gener. app.	Stature	Breed char.	Back Rump	Feet Legs	Dairy char.	Chest Brl.	Mammary	Fore udder	Rear udder	Teats	Ligament	Quality
I	.680	.719	.728	.762	.753	.763	.739	.622	.725	.805	.723	.771	.655	.621
II	.824	.823	.850	.813	.860	.861	.827	.699	.891	.902	.887	.885	.833	.860
III	.941	.937	.931	.937	.927	.928	.926	.931	.937	.935	.935	.936	.938	.927
IV	.810	.809	.932	.821	.857	.856	.826	.708	.874	.893	.870	.879	.814	.830
V	.870	.878	.884	.903	.887	.880	.888	.869	.870	.894	.874	.894	.863	.839
VI	.734	.754	.792	.779	.799	.806	.784	.671	.780	.858	.780	.816	.713	.669
VII	.836	.854	.900	.842	.917	.913	.868	.738	.950	.951	.947	.949	.884	.910
IX	.847	.836	.882	.843	.906	.902	.862	.744	.934	.941	.990	.940	.867	.881
X	.919	.923	.942	.956	.945	.933	.952	.931	.930	.949	.956	.954	.926	.900

dex IV) had correlations near .90 for most component traits with daughter average for all sires. These 3 measures were similar in evaluating these sires. The 2 indexes that had the lowest correlations with daughter averages were daughter deviations from contemporaries (Index III) and daughter averages deviated from contemporaries and adjusted for numbers (Index VIII). These correlations were especially low for final score, .697 and .680, respectively.

Deviations of daughters from contemporaries adjusted for number of daughters (Index VIII) would logically help remove discrepancies due to age, daughter numbers and herd effects. Therefore this score was correlated with the other 9 indexes and these results are presented in Table 6. Adjusting for daughter numbers in Index VIII did not substantially alter the evaluation of sires from daughter deviations from contemporaries (Index III). Correlations between these 2 indexes for all traits were above .92. Deviations of daughters from adjusted contemporaries and adjusting for daughter numbers (Index X) were correlated above .90 with Index VIII. The other indexes failed to yield correlations consistently above .90. That both age and herd effects are important is substantiated by the 6 indexes not correcting for one or both of these effects, having correlations less than .90 with contemporary comparisons. Scores of young sires were considerably enhanced by both contemporary comparisons while scores of older sires were depressed.

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