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Abstract

Daughter superiorities of 240 Holstein bulls of the American Breeders Service and Eastern Artificial Insemination Cooperative (EAIC) were estimated from records of paternal sisters of the sire, dam's records, and records of daughters of the maternal grandsire. Estimated daughter superiority (EDS) was then compared with the U.S. Department of Agriculture's predicted difference for American Breeders Service bulls and with the Northeast Sire Comparison for EAIC bulls. The regression equation on estimated daughter superiority was [−84 + .561(EDS)] kg for American Breeders Service bulls and [−227 + .654(EDS)] kg for EAIC bulls. The response is not as large as theoretically predicted but does indicate that selection of young bulls with high estimated daughter superiority is an effective method of finding a superior group of young bulls for further sampling.

Introduction

Selection of bulls to use heavily by artificial insemination (AI) makes the major contribution to genetic improvement of dairy cattle. Bull selection in AI typically occurs in two stages. First, young bulls are purchased or matings are contracted to produce young bulls based on records of animals in the pedigree. Second, the young bulls are sampled in AI with the best to return to service after their daughters are evaluated. The purpose of this study was to examine the effectiveness of first stage selection on three points in the pedigree of the young bull—his sire's daughters, his dam's records, and daughters of his maternal grandsire.

Data

Since 1961 New York Artificial Breeders, now Eastern Artificial Insemination Cooperative (EAIC), have submitted for research purposes, pedigrees of matings to produce young Holstein bulls to the extension division of the Cornell University Animal Science Department. In 1970 American Breeders Service (ABS) made available similar pedigrees on their young Holstein bulls selected since 1963. Eastern Artificial Insemination Cooperative pedigrees were complete at the time of the mating that produced the young bulls. American Breeders Service pedigrees were completed when the young bull first entered into service. Thus, pedigrees of ABS bulls include records up to two years later than those from pedigrees of EAIC bulls born at the same time. By January 1971, 240 of these bulls had been proven in AI. The most recent U.S. Department of Agriculture's predicted difference (PD) (1) was used to evaluate ABS bulls, and the Northeast Sire Comparison (SC) (2, 4) was used to evaluate EAIC bulls. The base period and assumptions for the evaluations are different so data for the two studs were analyzed separately since PD and SC are not directly comparable. In addition, any genetic trend would make the two-year lag in records an important difference for the two studs. In addition ABS sires are used nationally and EAIC sires primarily in the northeastern United States.

Estimated daughter superiority (EDS), a prediction of one-half the genetic value, of the young bull was calculated from three points in the pedigree of ABS and EAIC bulls. The three points were the average of records of daughters of the sire, the average of records of the dam, and the average of records of daughters of the maternal grandsire (MGS). Weights for the three averages (5) assumed all daughters of sire and maternal grandsire had only one record, heritability of .25, repeatability of .50 for records of the dam, and environmental correlation among natural service daughters of .0625. Estimated daughter superiority as well as PD or SC attempt to estimate one-half the genetic value of the young bull but utilize ancestor data in the first case and progeny records in the latter.

The essential features of the data are summarized in Table 1. American Breeders Service bulls had more records in all points of the pedigree than EAIC bulls which may be due to when the pedigrees were prepared. Records

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TABLE 1. Averages of superiority over herdmates and average numbers for sire groups, maternal sire groups (MGS), dams, and for estimated daughter superiority (EDS) and predicted difference (PD) or sire comparison (SC).

Stud	Sire	Dam	MGS	EDS	PD or SC
			(kg of milk)		
ABS	379	1,537	251	347	110
EAIC	411	1,864	334	383	23
	Number of daughters/ sire	Number records	Number of daughters/ sire		
ABS	1,389	4.8	1,935		
EAIC	594	3.6	1,828		
			Ranges (kg of milk)		
ABS					
High	980	4,092	618	599	987
Low	0	42	−342	20	−327
EAIC					
High	1,253	4,593	1,310	660	522
Low	−21	106	−362	140	−680

in pedigrees of EAIC bulls, however, averaged slightly higher in all pedigree points and in estimated daughter superiority than ABS bulls. From the range of high and low values, both studs apparently relaxed their selection standards at times for points in the pedigree or for the EDS.

Pedigree estimates of genetic value were substantially higher than estimates from daughter proofs. Part of this difference could be explained by genetic trend since the average pedigree record is probably compared to herdmates averaging 8 to 10 years earlier than herdmates of daughters of young bulls.

Multiple regressions of PD or SC on records in the pedigree determined weights which would have been most appropriate for estimating PD or SC. Simple correlations were also computed.

Results and Discussion

Simple correlations in Table 2 cannot be compared to correlations expected from genetic theory because of the highly selected sires and dams in the pedigrees. Nevertheless, the near zero correlations between sire group average (sire) and dam records indicate that matings between selected sires and dams may be nearly random, that is, high dams are not used to balance low sires, etc. The sire information was most highly correlated with the SC proof for EAIC, but maternal grandsire information had the highest correlation with the PD for ABS. In fact, the correlation of MGS with PD for

TABLE 2. Simple correlations, actual and expected with no selection, among averages of sire groups, maternal sire groups (MGS), dams, predicted difference (PD), or sire comparison (SC) and estimated daughter superiority (EDS) and PD or SC.

	Actual data		Expected with no selection[a]	
Groups	ABS	EAIC	ABS	EAIC
Sire, Dam	.01	.03	0	0
Sire, MGS	−.05	.09	0	0
Dam, MGS	.12	.18	.32	.31
Sire, PD or SC	.14	.26	.41	.40
Dam, PD or SC	.07	.08	.26	.26
MGS, PD or SC	.21	.07	.20	.20
EDS, PD or SC	.27	.30	.49	.49

[a] Expected correlations computed assuming no relationship among sires and dams and sires and MGS, heritability = .25, repeatability = .50, 30 daughters in PD, and numbers of daughters of sire and MGS and records per dam from Table 1.

TABLE 3. Multiple correlations (R) and weighting factors for linear prediction of predicted difference (PD) or sire comparison (SC) from the average of daughters of the sire, dam's average, and average of the daughters of the maternal grandsire.

ABS (PD)					EAIC (SC)				
	Weights					Weights			
EDS	Sire	Dam	MGS	R	EDS	Sire	Dam	MGS	R
......	.167	.013	.241	.265	......	.306	.019	.036	.267
......	.157	......	......	.143	......	.312	......	......	.256
......	......	.021	......	.074	......	......	.024	......	.075
......	......	......	.239	.211	......	......	......	.070	.071
......	.156	.020	......	.161	......	.310	.022	......	.264
......	.168	......	.247	.261	......	.307	......	.047	.260
......	......	.014	.232	.217	......	......	.020	.058	.094
.561	......	......	......	.273	.654	......	......	......	.299
2.032	−.595	−.144	−.077	.374	1.445	−.298	−.075	−.126	.331
Theoretical weights to predict daughter superiority which estimates PD or SC from pedigree[a]									
......	.477	.084	.161	.492	......	.461	.078	.160	.487

[a] Calculated from the numbers in Table 1, $h^2 = .25$ and $r = .50$.

ABS bulls was as large as the correlation expected with no selection on MGS.

Partial regressions on pedigree records for PD or SC should be unbiased by selection if the usual assumption of a linear relationship between genetic value of an animal and a relative is true. These regressions and regressions using only part of the pedigree are in Table 3. The bottom line of the table gives theoretical selection index weights.

Generally poor agreement between the empirical regression coefficients and the theoretical weights is apparent. The other obvious result is the small regression coefficient for dam's records for predicting her son's PD or SC. The dam's records also do not add much to the multiple correlation with either PD or SC. Such a result does not imply that records of the dam are unimportant in selecting young bulls since most of these dams are highly selected as evidenced by their high average production. What is implied is that among such a group of selected dams differences among them are of little importance in predicting a son's daughter superiority. Freeman (3) has shown that later records on a dam may be a poor indicator of her genetic transmitting ability especially if her first record is large enough to mark her as a potential dam of young sires. As a designated cow her later records may be made with preferential treatment.

The sire average is expected to have about three times as much weight as maternal sire groups (MGS) but as shown in Table 4 the best use of the data to predict differences for ABS bulls would have been to give MGS about 50% more weight than the sire and to predict SC for EAIC bulls would have been to give the sire eight and one-half times more weight than MGS. The reasons for such differences in relative importance of sire and MGS between the studs is not clear. Recall again that the regressions are not biased by selection. Some possible causes of the differences from theory may be disproportionate use of bulls in various regions of the country having different genetic merit. The difference in the PD and SC calculations and assumptions may also play a part that is not clear. What is clear from the past is that the maternal grandsire has had more predictive value for ABS young bulls than the sire while the MGS has had little predictive value for EAIC bulls.

Somewhat surprisingly the EDS from pedi-

TABLE 4. Theoretical and empirical weighting factors to predict predicted difference (PD) or sire comparison (SC) standardized so that sum of weights equal unity.

	Theoretical Weights			Empirical Weights		
Stud	Sire	Dam	MGS	Sire	Dam	MGS
ABS	.661	.116	.223	.397	.031	.572
EAIC	.660	.112	.229	.848	.053	.100

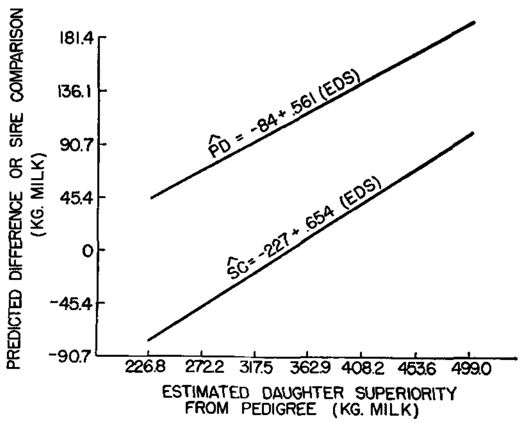

FIG. 1. Regression of daughter superiority estimated as predicted difference or sire comparison on pedigree estimate of daughter superiority.

gree records is a slightly but insignificantly better predictor of PD or SC than weighting by regression the three components that make up EDS. Use of the EDS and the raw averages of the three relatives in the regression equations adds to the correlation with PD or SC although the reason for this increase is not apparent since such a procedure amounts to a duplication of the independent variables.

Conclusions

So far a question has arisen whether the EDS procedure is effective in selecting young bulls on their pedigree. The real proof is in whether such selection gives results, not whether the results are as good as expected. Figure 1 shows linear regressions of PD and SC on EDS. Except for the difference in intercepts the regressions are quite similar with standard errors of about .187. As suggested earlier the difference in intercepts probably is due partly to the difference between PD and SC base values and the difference in the average lag period for pedigree records and daughter records.

Although, optimistically, a one for one relationship would be preferred, on the average about .61 units of PD or SC result from the increase of one unit of EDS. If heritabilities less than .25 had been used in the EDS calculations the regressions of PD and SC on EDS may have been closer predictors of PD and SC. Nevertheless, selection of high EDS young bulls is a very effective method of gathering a superior group of young bulls for further sampling in AI although the necessity of maintaining high standards for young bulls is obvious.

References

(1) Agricultural Research Service. 1971. USDA-DHIA sire summary list. USDA, Beltsville, Maryland. January.

(2) Cornell University, 1971. Northeast A. I. sire comparison. Dep. Animal Sci., Ithaca, New York, January.

(3) Freeman, M. G. 1970. What has been realized from pedigree selection of bulls? Invitational paper. Amer. Dairy Sci. Ass. Annu. Meeting, Univ. Florida, Gainesville. June 30.

(4) Henderson, C. R. 1970. A new sire evaluation method. Proc. 23rd Annu. Conv. Nat. Ass. Artificial Breeders.

(5) Van Vleck, L. D. 1969. Relative selection efficiency in retrospect of selected young sires. J. Dairy Sci., 52: 768.