PROBLEMS IN EVALUATING DAIRY SIRES

Probleme in der Züchtwertschätzung von Milchviehbullen

Problemas en la evaluación de toros reproductores de razas lecheras

R. W. EVERETT *

The objectives of any sire evaluation system is to maintain the greatest genetic progress by obtaining the most accurate genetic evaluation using the available resources. The system must predict genetic merit ith the fewest possible errors and provide for easy interpretation of results for monitoring all aspects of the industry.

The herdmate method of sire evaluation (4) and the young sire program (2) were implemented in New York State in 1954 and 1952, respectively. The young sire program is based on the assumption that selected young sires vary greatly and only an artificial insemination (A. I.) proof can distinguish these differences accurately. The herdmate comparison was designed to evaluate sires taking into account year and season of freshening, age at freshening and the herd effect. Assumptions necessary for unbiasedly estimating genetic differences (5) between sires are:

1. all records are properly adjusted for age, days in milk and times milked,
2. A. I. sire daughters are distributed randomly among herds,
3. A. I. sires are a random sample from a single population,
4. herd-year-seasons are a random sample from a single population,
5. no genetic trend exists,
6. the records used are unselected,
7. the mates of each sire within a herd are a random sample of all possible mates in the herd, and
8. differential environment within the herd is random with respect to sires.

* New York State College of Agriculture & Life Sciences, Cornell University, Department of Animal Science, Frank B. Morrison Hall, Ithaca, New York 14850, United States.

MILLER *et al.* (6) studied seasonal age correction factors when it was found that sire proofs were biased when all daughters of a sire calved in the same season. Elimination of biases due to environmental trend, herd differences and selection revealed a month of calving by age interaction of sufficient magnitude to bias sire proofs. Calendar month by age at freshening multiplicative factors were developed when months could not be satisfactorily grouped into seasons.

Further research revealed that daughters of each A. I. sire are not randomly distributed among herds. Dairymen tend to use the services of a specific A. I. organization or natural service sires. (Therefore, daughters of A. I. sires are randomly distributed among herds with similar breeding programs).

Young sire sampling programs vary between A. I. studs on the number of traits, the relative importance of various traits, salability associated with names in the pedigree, and the selection standards for sires and dams. Therefore, young sires within A. I. studs are more alike than sires between A. I. studs which nullifies the assumption that A. I. sires are a random sample from a single given population.

Genetic trend for milk production has been estimated (5) to be in the order of 50 Kg per year; thus, A. I. sires used in different years are not from the same genetic population. Genetic trend within the non-A. I. populantion has been estimated at 15 Kg per year. Assuming the A. I. and non-A. I. populations were the same in 1950, the difference between the two genetic trends implies that the A. I. population is advancing 35 Kg of milk per year faster and the two populations are different today. The herdmate comparison assumes all sires are from the same population and thus are regressed toward a common mean by use of repeatability. A. I. sires from the superior genetic population are severely handicapped by a regression toward a common mean located between the A. I. and non-A. I. populations. Likewise, non-A. I. sires with a low repeatability are regressed to a base higher than their true genetic merit and thus appear to be better than their true genetic merit. To combat this situation, it was proposed that proofs be properly labeled as «true A. I.» and «non-A. I.». This has not been accomplished.

HENDERSON obtained the average proofs of the sires of the herdmates of daughters of every A. I. sire and found the sires of the herdmates ranged from 192 Kg to – 342 Kg for true A. I. sires. The herdmate comparison assumes the average competition for all sires to be zero. Certain sires are misevaluated depending on the herds in which they are used. It is especially important to adjust for this bias in young sires' proofs. Dairymen in the northeastern United States have been encouraged to use young sires on 10 percent of their herd and A. I. proven sires on the rest. Thus, the main competition of the young sire is the A. I. proven sire which certainly is not random competition.

SLANGER (8) studied the mates of A. I. sires and found the range of differences in mates between sires was 583 Kg to – 437 Kg. The average bias was zero with a standard deviation of 20 Kg. There were differences between sets of mates of sires; however, there was no correlation between the sire's genetic merit and the average value of the mates. It was concluded that the addition of the dam's values to sire evaluation would add little information.

SCHAEFFER *et al.* (7) studied the effects of days open on first lactation sire evaluations and found that evaluations changed when adjusted for days open even for sires having more than 2,000 daughters. The average change in evaluations

due to days open was near zero with a standard deviation of about 40 Kg of milk. The correlation between days open adjusted evaluations minus the unadjusted evaluations with unadjusted evaluations was zero indicating changes due to adjusting for days open was independent of a sire's genetic merit. The practical problem of delaying a sire's evaluation until his daughters have freshened for a second lactation makes this unacceptable except for evaluations on the sires of young sires.

HENDERSON (3) developed the Northeast A. I. Sire Comparison (NEAISC) using mixed model techniques (1) to obtain the best linear unbiased prediction (BLUP) of a sire's genetic merit based on the model:

$$y_{ijkl} = h_i + g_j + s_{jk} + e_{ijkl}$$

where:

y_{ijkl} = is the first lactation record of the l^{th} daughter of the k^{th} *AI* sire of the j^{th} genetic group made in the i^{th} herd-year-season,
h_i = is the fixed effect associated with the i^{th} herd-year-season,
g_j = is the fixed effect associated with the *AI* sires in the j^{th} stud year,
s_{jk} = is the random effect associated with the genetic merit of the k^{th} *AI* sire located in the j^{th} stud year, and
e_{ijkl} = is the random error.

A sire's evaluation is $\hat{g}_j + \hat{s}_{jk}$ and the difference between any two $\hat{g}_j + \hat{s}_{jk}$ has known properties and is BLUP of the differences between the two sires.

The NEAISC has been operational since 1968, and evaluations have been published semi-annually since 1970. Results have demonstrated that this procedure:

1. properly accounts for genetic trend,
2. properly accounts for the sires of the herdmates,
3. provides solutions for sires which have the properties of BLUP, and
4. provides solutions for stud years (g_j) which are extremely valuable in monitoring genetic progress.

The procedure does not take into account any errors caused by the nonrandom selection of mates for a given sire or preferential treatment.

Future refinements and improvements other than the incorporation of adjustments for days open are partially dependent on advances in computer hardware and algorithms. The incorporation of cow evaluations and a complete relationship matrix would be the ultimate.

SUMMARY

The herdmate method of sire evaluation was implemented in 1954. Research has demonstrated that the herdmate comparison has been biased by incorrect adjustment for age at freshening, genetic trend, genetic differences between sire sampling programs, monrandom distribution of A. I. sires among herds and monrandom sampling of mates within a herd. There are differences between sires in days open which are independent of milk production. The best linear unbiased prediction of differences between sires can be obtained by use of the Northeast

A. I. Sire Comparison which eliminates biases due to genetic trend, differences between studs and nonrandom distribution of A. I. sires among herds.

ZUSAMMENFASSUNG

Die «herdmate» Methode zur Zuchtwertschätzung der Bullen wurde 1954 eingeführt. Untersuchungen haben gezeigt, dass der Herdengefährtinnenvergleich durch ungenaue Korrektur für Erstkalbealter, genetischen Trend, genetische Unterschiede zwischen verschiedenen Bullenprüfprogrammen, keinen zufallsgemässen Einsatz der A. I. Bullen in den verschiedenen Herden und keine zufallsgemässe Auswahl der angepaarten Kühe innerhalb einer Herde verzerrt ist. Es sind Unterschiede zwischen den Nachkommenschaften der verschiedenen Bullen in der Zwischenkalbezeit vorhanden, die unabhängig von der Milchleistung sind. Der beste, lineare, unverzerrte Schätzwert für die Unterschiede zwischen Bullen kann mit Hilfe der «Northeast A. I. Sire Comparison» erhalten werden, die Verzerrungen, hervorgerufen durch genetischen Trend, Unterschiede zwischen verschiedenen A. I. Organisationen und nicht zufallsgemässen Einsatz der Bullen zwischen den Herden, eliminiert.

RESUMEN

En 1954 se instauró el método de la Comparación con las Compañeras de Establo para la evaluación de los reproductores de razas vacunas lecheras. Posteriormente se demostró que esta comparación está sujeta a oscilaciones ocasionadas por las siguientes causas: incorrección en los ajustes por edad al parto; progreso genético; diferencias genéticas en los programas de muestreo de los toros; distribuciones no al azar de los toros en servicio para la inseminación artificial de los apareamientos dentro del establo. Existen diferencias entre los grupos de progenie en cuanto a la duración del intervalo parto-monta, que son independientes de la producción de leche. La «mejor» predicción lineal no afectada por estas oscilaciones en las diferencias entre toros se logra utilizando el método de Comparación de Toros del Nordeste (*Northeast A. I. Sire Comparison*), que elimina las tres últimas causas de distorsión previamente mencionadas.

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