THE ACCURACY OF CENTRAL BULL PERFORMANCE TESTS IN NEW ZEALAND AS EVALUATED BY SUBSEQUENT PROGENY TESTING

Evaluacion de la effectivad de centrales de pruebas en Nueva Zelandia en base a pruebas de progenie de campo

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NEW ZEALAND

INTRODUCTION

Central performance tests of beef bulls are used in many countries as the basis for selecting among sires originating in different herds. Commonly, bulls from several herds are moved to a central location at 6 to 10 months of age (soon after weaning), and grazed as a single group or fed-out in feedlots for 150 to 300 days. The bulls are then ranked for final weight or gain on test, and these rankings used as a basis for making selection decisions.

The Farm Production Division of the New Zealand Dairy Board (NZDB) has conducted four central performance tests of this type using Hereford bulls. Each of these tests has been followed by a progeny test. In choosing bulls to be progeny tested, care was taken to include bulls with both high and low performance test results. As well as identifying progeny tested bulls with high breeding values for growth traits for use through artificial insemination, this study also permitted the accuracy of these performance tests to be evaluated. To our knowledge central performance tests have not previously been checked in this manner either in New Zealand or overseas. The results of the first of these central performance tests and subsequent progeny test results were reported by Wickham (1977).

MATERIALS AND METHODS

Central performance tests

Four annual central performance tests were conducted beginning with young polled Hereford bulls purchased soon after weaning in the autumn of 1972-75. Details of ages, starting and final weights and weight gains on test are given in Table 1 for all bulls completing the tests. From nine to thirteen registered bull breeding herds (studs) participated each year to supply bulls. A total of sixteen independent studs took part over the four years. All herds except one were members of the national beef recording programme (Beefplan).

The criteria used by the NZDB personnel to select and purchase young bulls from the individual studs varied with each intake. For example, for the first intake (1972) bulls were selected on the basis of the weaning weights of their dam's previous progeny. In subsequent intakes weaning weights of the bulls themselves, relative to their contemporaries in the herd, and/or ancestry information was used as available. This resulted in considerable variation among intakes in age at the start of test which was also reflected in starting and final weights, and gain on test (Table 1).

The central test bulls were pasture-fed, with only hay supplementation in the winter. Liveweights were taken at about monthly intervals. However, only

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start and final weights are reported here, each being the average of weights on two successive days. Gain on test and average daily gain on test were also calculated.

Progeny tests

Progeny tests were arranged using inseminations to Jersey or Jersey-Friesian cross cows in the northern half of the North Island, with the objective of obtaining about 20 progeny per sire.

The sample of central test bulls subsequently progeny tested was designed to represent bulls with low as well as high performance for final weight on test. In total 66 of the 100 bulls completing the central performance tests were progeny tested (Table 1). An additional 16 bulls were progeny tested, including, for example, semen from overseas bulls. Reference sire links among the four progeny tests were provided both by some of these additional bulls, and by centrally tested bulls with repeated progeny tests.

Calves were reared by the co-operating dairy farmers in up to 70 herds. In some years method of rearing was recorded, usually as suckling on foster cows or artificially using bucket rearing. At approximately four months of age, calves were collected and transported to the Newstead Artificial Breeding Centre, Hamilton, where they were run as two groups. In the first progeny test, approximately equal numbers of steers and heifers were run as two separate groups. In subsequent tests, only small numbers of heifers were collected and these were distributed across the two grazing groups. Weights were recorded at approximately monthly intervals with double weighing at the start and finish of the test. On average the test period was about 440 days. At the end of each test, all crossbred progeny were slaughtered on a fixed date basis, with successive slaughter groups balanced for sire. Carcass weights and some carcass measures were recorded, but only progeny final weight and gain on test were analysed for this paper.

Statistical analyses

Just two central performance test growth traits are considered here; namely, gain on test and adjusted final weight. Final weight was adjusted for both calf age and age of dam. Calf age adjustments were by linear regression analysis to the average final age in each intake. Standard additive age of dam adjustment for Hereford bull calves used in the New Zealand national beef recording programme (Beefplan) were used.

Several progeny test analyses were conducted for start and final weight. The models used as the basis for calculating sire evaluations were different for each test but included grazing group, herd, sex, and rearing method as fixed effects, age as a linear covariate, and sire as a random effect. After data from the fourth progeny test became available, a final analysis was carried out which consisted of mixed linear model with the random sire effect cross-classified with the four progeny tests. Under this model best linear unbiased predictions (BLUP) were obtained for each sire.

The agreement between the performance and progeny tests were then quantified using linear correlations or regressions pooled within the four annual central test intakes.

RESULTS AND DISCUSSION

The correlation between central performance test and progeny test results

for final liveweight was 0.15 which was not significantly different from zero. The expected correlation is $1/2\ h^2[n/(1+(n-1)t)]^{1/2}$, where h^2 is the heritability of the trait, n is the number of progeny and $t = 1/4\ h^2$ assuming common environmental effects (e.g. pre-test environmental effects) are unimportant. Thus the expected correlation for a trait with a heritability of 0.35 and an average of 20 progeny per sire is 0.48 which is significantly different from the observed correlation of 0.15. The regression of offspring on sire can be used to derive the effective heritability for final liveweight which was 0.06±.06. This is significantly different from the value of 0.35-0.45 found in New Zealand and elsewhere for within-herd estimates of the heritability of 18-month liveweight under grazing conditions.

One of the main purposes of a central performance test is to allow genetically superior bulls to be identified. If the central performance test is successful in doing this then there should be a positive correlation between performance test and progeny test results. The four central performance tests analysed here were shown, by subsequent progeny tests, to give a poor indication of the genetic merit of individual bulls. In contrast, on-farm performance tests have been checked in a similar manner under New Zealand farming conditions (Carter, 1971; Baker et al., 1975), and were found to be as accurate as expected from the relevant heritabilities.

Reasons for the worse than expected relationship between central test perfomance results and breeding values estimated from progeny testing have not been fully examined, but almost certainly relate to pre-test environment effects and age at the start of the performance tests. Dalton and Morris (1978) reviewed New Zealand experiments where the subsequent effects of differences induced by early feeding treatments on calves were compared. From trials with a variety of different treatments and objectives, over 70% of the original live-weight differences induced by early feeding persisted to the end of 12 of the 21 trials. From this review Dalton and Morris questioned the merit of central tests with bulls starting on test at 6 to 10 months of age. The pre-test environmental effect is likely to be less important or possibly unimportant, if bulls are started on test at an early age (Preston and Willis, 1970). Lewis and Allen (1974) reported that the starting age for calves in performance tests in mainland Europe had been reduced to 50 days in the Federal Republic of Germany, 45 days in Denmark and 30 days in Sweden. In all these cases this reduction was achieved because the bulls were derived from dual-purpose herds and artificially reared.

A possible solution to circumvent the pre-test environmental effect which has been widely suggested is to rank bulls in central performance tests on gain on test rather than final liveweight. To the extent that there is compensatory growth during the test period, a negative correlation between start weight and subsequent rate of gain is expected and often observed (Morris, 1981). On the other hand, the existence of real genetic differences between animals in rate of gain would result in a positive correlation between start weight and subsequent gain on test. The observed phenotypic correlation is, then, composed of these two opposing effects and is of little value as evidence as to the relative merits of gain on test or final weight as suitable criteria for ranking bulls. To obtain a clearcut answer to this question it is necessary to evaluate central performance test growth criteria in terms of their ability to accurately rank progeny as has been done in this study. Final analyses and full publication of this work will address this question. Preliminary analyses suggest that gain on test is no better, and possibly worse, than final weight as a selection criteria in these New Zealand central performance tests.

It has already been noted that New Zealand research results have shown

TABLE 1
Parameters describing the central performance tests and the number of bulls progeny tested.

Parameters	Total or mean	Range among the four yearly intakes
Number of bulls finishing test	100	18-28
Age at start of test-days	297	271-341
Range of ages at start of test-days	68	66-77
Age at end of test-days	570	551-581
Test length-days	273	238-329
Start weight-kg	275	253-295
Final weight-kg	535	505-593
Gain on test-kg	260	230-340
Average daily gain on test-kg/day	0.95	0.86-1.03
Number of bulls progeny tested	66	12-21

good agreement between performance and progeny testing within a herd, suggesting that more emphasis on within-herd performance recording is required. Morris, Jones and Hopkins (1980) have demonstrated the usefulness of reference sire progeny test schemes to provide accurate rankings of sires across herds. They also found that this sort of progeny test selection, in combination with within-herd selection programmes, can be more effective than individual within-herd selection programmes in producing annual genetic change for growth.

Given the continued popularity of central performance testing in many countries around the world it would appear prudent that more research of the type reported here be undertaken to evaluate their real effectiveness.

SUMMARY

The New Zealand Dairy Board conducted four central performance tests (1972-75) using Hereford bulls. A total of 100 bulls were performance tested from 16 different herds of origin. The bulls started the performance tests at an average age of 297 days and at an average weight of 275 kg. They remained on test for 273 days, gained in weight at 0.95 kg/day, resulting in a final weight off test of 535 kg. A total of 66 bulls were representatively sampled (including bulls with high and low performance test rankings) from the 100 bulls performance tested and were progeny tested, using inseminations to Jersey or Jersey-Friesian cross cows in 60-70 different dairy herds. Progeny (about 20 per sire) were reared on foster dams or artificially, were assembled in one location at about four months of age, and reared together for 14 to 15 months prior to slaughter. The correlation between central performance test and progeny test results for final liveweight (at about 550 days of age) was 0.15 which was not significantly different from zero. The effective heritability, from offspring-sire regression, was 0.06 for final liveweight. This is significantly different from the value of about 0.35-0.45 found in New Zealand and elsewhere for "within-herd" estimates of the heritability of 18-month liveweight. It is concluded that central performance tests, as presently organised in New Zealand, are of limited value for ranking breeding values of bulls for growth traits. It is suggested that the effectiveness of similar central performance testing programmes in many other countries around the world needs validation.

R E S U M E N

El New Zealand Dairy Board realizó cuatro pruebas centrales de rendimiento (1972-75) utilizando toros Hereford. Se controlaron los rendimientos de un total de 100 toros de 16 establos de origen diferente. Los toros comenzaron la prueba de rendimiento a una edad media de 297 dias con un peso medio de 275 kilos. Permanecieron en prueba durante 273 dias, ganando en peso alrededor de 0,95 kg/día, y resultando un peso final de 535 kg. Se obtuvo una muestra representativa de un total de 66 toros (inluídos toros con alto y bajo rendimiento en la prueba) a partir de los 100 toros controlados, y se practicó la prueba de la descendenciautilizando inseminaciones en cruce con vacas Jersey o Jersey-Friesian en 60-70 diferentes establos lecheros. La diferencia (alrededor de 20 por padre) se crió con nodrizas o artificialmente, reuniéndose en una misma unidad a los 4 meses aproximadamente de edad, y explotándose conjuntamente durante 14-15 meses antes del sacrificio. La correlación entre la prueba central del rendimiento y los resultados de la prueba de la descendencia para el peso vivo final (a alrededor de los 550 dias de edad), fué de 0,15, que no es significativamente diferente de cero. La heredabilidad efectiva, según la regresión descendencia-padre, fué de 0,06 para el peso vivo final. Ello es significativamente diferente del valor de alredor de 0,35-0,45 encontrado en Nueva Zelanda y en otros lugares para estimaciones "dentro del establo" de la heredabilidad del peso vivo a los 18 meses. Se deduce que las pruebas centrales de rendimiento, como actualmente se organizan en Nueva Zelanda, son de valor limitado para establecer los valores de mejora de los toros para los caracteres del crecimiento. Se sugiere que la efectividad de análogos programas centrales de prueba del rendimiento en otros muchos paises alrededor del mundo, necesitan una comprobación.

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