THE RELATIONSHIP BETWEEN CENTRAL TEST STATION PERFORMANCE AND SUBSEQUENT PROGENY PERFORMANCE FOR GROWTH TRAITS OF HEREFORD BULLS

B. W. WICKHAM

N.Z. Dairy Board, Wellington

SUMMARY

Twenty-seven Hereford bulls entered a "central" performance test at an average age of 270 days and remained on test for 280 days. A sample of 19 was selected for progeny testing. The progeny test was conducted using steer and heifer Jersey cross animals. It commenced when the progeny average age was 125 days and lasted 436 days. Correlations between "central" performance and progeny traits were found to be 0.33 and 0.26 for final liveweight and gain, respectively. These correlations were not significantly different from an expected value of 0.61. Studies at present being conducted will provide a more precise estimate of the value of "central" performance tests.

INTRODUCTION

Performance testing of beef animals is a tool widely used to aid in the selection of beef sires. Performance tests can be broadly classified as either "on-farm" or "central" according to whether animals from one or several farms are included in the test. In both cases the "test" is a comparison of the final weight or gain on test of all the animals included. The accuracy of a performance test is measured by its ability to genetically rank the animals. Checking performance test accuracy requires independent measures of the animals' genetic values. These are usually obtained by means of progeny tests. "On-farm" performance tests have been checked under New Zealand conditions (Carter, 1971; Baker *et al.*, 1975) and were found to be as accurate as expected from the relevant heritabilities.

"Central" tests have not previously been checked in this manner in New Zealand or overseas. A disadvantage of "central" performance tests is that they contain biases due to the different farms or environments from which animals originate. These biases have serious implications if there are large environmental differences between farms, and these differences persist into the test period. Everitt *et al.* (1969) observed a large contribution of herd to variation in 360-day weights of animals entering "central" performance tests at approximately 120 days of age. Many "central" performance tests involve only one or two animals from each of 10 to 15 herds. In these circumstances it may be possible, for an individual farmer, to provide an environment which greatly enhances the chance of his animals being highly ranked. This is even more likely for tests which commence at an older average age.

The potential advantage of central performance tests is that they may allow between-herd genetic comparisons. The N.Z. Dairy Board is conducting a series of three "central" performance tests followed by progeny tests in an attempt to assess the magnitude of these problems as well as to obtain progeny tested bulls for use through artificial insemination. In this paper the results of the first of these are presented.

EXPERIMENTAL

In the autumn of 1972, 27 Hereford bulls were purchased from 9 different studs. The bulls were selected on the basis of the weaning weights of their dam's previous progeny. This was done to help minimize their age at the start of the test. The test commenced on May 9 when the bulls' age averaged 270 days (range 67 days) and weight averaged 264 kg. Weighings were made at approximately 28-day intervals for the duration of the 280-day tests.

In the spring of 1973 semen was collected from 19 of these bulls and used to inseminate Jersey cows in herds in the South Auckland area. The progeny were reared by the co-operating farmers. The method of rearing was either by suckling on foster cows or artificial feeding. In all, 62 different herds contributed progeny. They were transferred to the Newstead Centre at an average age of 125 days and run in two mobs, heifers and steers separately, for the 436 days of the test period. Weights were recorded at approximately 28-day intervals with a double weighing at the commencement and finish of test. All animals were slaughtered and carcass weight, carcass grade, eye muscle area and fat depth recorded.

RESULTS

Table 1 shows the performance test rankings of the 19 bulls selected to be included in the progeny test. Two other horned Hereford bulls which had been progeny tested in the United Kingdom were also included.

Table 2 contains the number of progeny by sex for each sire and their average liveweights.

TABLE 1: PERFORMANCE TEST RANKINGS OF 19 BULLS INCLUDED IN PROGENY TEST

NZDB Code Number	*Ranking on Performance Test* Start Wt	Final Wt	Gain
72600	26	4	1
72601	7	19 =	23 =
72602	19	16 =	17
72604	8	8	7
72606	13 =	21 =	21
72609	15	11	8
72610	11	2 =	2
72611	1	5	15 =
72613	27	10	4
72615	23 =	25	23=
72617	17	13 =	12
72618	21	15	10
72619	9	19 =	22
72620	18	24	20
72621	20	26	26
72622	5	6 =	9
72623	3	2 =	6
72624	4	6 =	11
72625	23 =	9	5

TABLE 2: NUMBER OF PROGENY AND AVERAGE PROGENY GROWTH FOR EACH OF 21 BULLS PROGENY TESTED

NZDB Code Number	*Number of Progeny* Male	Female	*Average Liveweights (kg)*[1] Start	Finish	Gain
66420	11	12	109	363	254
66520	12	16	103	365	262
72600	11	11	96	352	256
72601	8	13	108	358	250
72602	13	6	86	329	243
72604	14	10	99	345	246
72606	5	16	96	322	226
72609	13	7	96	354	258
72610	11	8	91	349	258
72611	7	6	107	364	257
72613	11	9	101	367	266
72615	10	11	104	334	230
72617	13	11	106	355	249
72618	9	11	100	338	238
72619	11	13	105	348	243
72620	8	10	108	368	260
72621	11	10	117	360	243
72622	9	9	108	352	244
72623	12	7	93	349	256
72624	11	10	96	355	259
72625	10	6	107	348	241

[1]Average of actual weights and gains unadjusted for age or sex.

TABLE 3: RESULTS OF PERFORMANCE AND PROGENY TESTS FOR 21 HEREFORD BULLS

NZDB Code Number	*Performance Test Wts (kg)*[1] *Start*	*Finish*	*Gain*	*Progeny Test Evaluations (kg)*[2] *Start*[3]	*Finish*[4]	*Gain*[5]
66420	—	—	—	4.1	15.1	11.0
66520	—	—	—	—0.7	12.4	13.1
72600	240	551	311	0.3	3.9	3.6
72601	272	480	208	2.2	6.4	4.2
72602	251	485	234	—6.3	—13.9	—7.6
72604	270	526	256	2.3	—0.8	—3.1
72606	262	475	213	—5.8	—19.8	—14.0
72609	262	513	251	—0.8	—0.4	0.4
72610	267	560	293	2.2	9.2	7.0
72611	301	537	236	4.6	13.0	8.4
72613	237	517	280	1.7	12.0	10.3
72615	246	454	246	0.2	—14.7	—14.9
72617	258	498	240	—0.8	—4.2	—3.4
72618	249	493	244	—3.1	—13.0	—9.9
72619	267	478	211	—0.6	—2.5	—1.9
72620	253	467	214	6.4	16.4	10.0
72621	250	429	179	2.1	—4.5	—6.6
72622	286	531	245	—6.3	—13.3	—7.0
72623	298	563	265	—1.1	—2.5	—1.4
72624	287	530	243	0.1	7.2	7.1
72625	246	522	276	—0.8	—6.3	—5.5

[1] Age adjusted.
[2] Estimated deviation of progeny from average of these 21 bulls.
[3] Prediction error standard deviation = 3.6.
[4] Prediction error standard deviation = 6.8.
[5] Prediction error standard deviation = 5.2.

TABLE 4: OBSERVED AND EXPECTED CORRELATONS FOR 19 HEREFORD BULLS WITH RESULTS FOR BOTH PERFORMANCE AND PROGENY TESTS

Correlation Between	*Observed*	*Expected*[1]	*Heritability*
Performance start weight and progeny start weight	0.03[2]	0.48	0.35
Performance final weight and progeny final weight	0.33	0.68	0.60
		0.61	0.50
		0.53	0.40
		0.68	0.60
Perrformance gain and progeny gain	0.26	0.61	0.50
		0.53	0.40

[1] Calculated assuming no pre-test environmental influence, using variances and covariances estimated in this study; assuming average of 20 progeny and heritabilities indicated.
[2] Significantly different from the expected correlation with $P < 0.05$.

Performance test start and finish weights were adjusted for age. Gain on test was then calculated as the difference between these adjusted figures. These are contained in the first three columns of Table 3 for the 19 bulls which were subsequently progeny tested.

The progeny start and finish weights were analysed using a mixed linear model in which herd, sex and rearing method were treated as fixed factors, age as a linear covariate, and sire as a random factor. Under this model best linear unbiased predictions (BLUP) were obtained for each sire. These are contained in the last three columns of Table 3. The BLUP value for a sire is a best estimate of his transmitting ability and should be doubled to give an estimate of his genetic value.

The agreement between the performance and progeny tests can be quantified using linear correlations. Table 4 contains these for each trait as well as the correlation expected from each trait's heritability. The expected correlations assume an insignificant contribution of herd to the performance test results.

DISCUSSION

The results in Table 4 provide a measure of the accuracy of "central" performance tests for the three traits, start weight, final weight and liveweight gain. For all three the accuracy observed is lower than expected from the heritability of these traits assuming pre-test environment is unimportant. This measure of accuracy is, however, based on the results of only 19 bulls and the difference from the expected correlation achieves statistical significance for start weight only.

Further studies are needed to obtain a more precise measure of the accuracy of "central" performance tests. Two trials are in progress at present.

The correlations observed have important implications for beef cattle improvement programmes. The consequences of 20 years of beef breeding under two alternative systems can be considered using a procedure recently developed (Wickham, 1976). Both alternatives assume 500 000 breeding cows, of which 60 000 are recorded on a system such as Beefplan. These 60 000 recorded cows are mated by artificial insemination to produce bulls which are naturally mated to the remaining 440 000 cows. Selection is assumed to be for 550-day weight.

The "central" performance testing alternative is compared with "on-farm" performance testing. A heritability of 0.40 for "on-farm" tests and 0.21 (corresponds to 0.33 correlation in Table 4) for "central" performance test is assumed. In both alternatives the 60 000 recorded cows are mated to the best 25 of the 22 500 performance tested males of the previous year in these herds. The next best 17% (3800) are then sold for use by natural mating in commercial herds. The critical difference between these two alternatives is the way in which animals from different performance tests are compared. The "on-farm" performance test allows selection within a farm and also selection between farms. The selection between farms is possible because of the use of common sires. "Central" performance tests allow selection on both a within-farm and between-farm basis but with a lower accuracy than the "on-farm" tests.

TABLE 5: AVERAGE CHANGE IN GENOTYPE (550 day wt in kg) OF MALES AND FEMALES IN TWO ALTERNATIVE BREEDING SYSTEMS FOR 20 YEARS
(Change after 10 years is shown in parentheses)

	"Central" Performance Test		*"On-Farm" Performance Test*	
Cows in breeder herds	20	(4)	29	(6)
Commercial cows	11	(1)	15	(1)
Young bulls entering performance test	28	(11)	39	(16)
Bulls selected from performance test	41	(25)	57	(35)
Bulls going to commercial herds	32	(16)	45	(23)

Table 5 shows the expected genetic gain for each alternative after a period of 20 years. These results are biased against "central tests" because it has been assumed that information provided by common sires would not be utilized but would be for "on-farm" tests. This bias is partially offset by a bias in the opposite direction through assuming "central" performance tests would result in the same number of animals being tested. This illustration is not intended to provide a definitive answer to the relative value of "central" and "on-farm" based performance testing breeding schemes. Only a detailed economic analysis can provide this.

"Central" performance tests were initially proposed as a means of comparing, genetically, animals from different herds. The results of this study cast doubt on the ability of performance tests, commencing at 8 to 9 months of age, to do this. Between-herd differences may be better handled using marker bull techniques as proposed by Everitt *et al.* (1976) or by ignoring them under an artificial breeding system. The latter alternative is reasonable where bull breeding herds use, through artificial insemination, only the best available performance or progeny tested bulls. After a period, a large part of the between-herd differences could be adjusted for by using a knowledge of male parents in each herd.

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