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ON-FARM PROGENY TESTING FOR BEEF PRODUCTION

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SUMMARY

Data drawn from a sire breed comparison trial, with particular reference to the growth performance and carcass characters of Simmental × Friesian steer progeny, are used to illustrate some principles of multiple-herd, on-farm progeny testing of beef bulls. As an extension of the system used in the breed evaluation trials, a model is proposed to allow comparisons between sires used by artificial breeding (AB) in several herds, between a naturally mated (NM) sire used on one farm and the AB sires, and between NM sires used in different herds.

INTRODUCTION

NATIONAL sire proving schemes have yet to evolve for the New Zealand beef industry. Several courses of development need examination.

On-farm performance testing of beef cattle (Baker and Carter, 1976) represents the foundation for sire proving, and the National Beef Recording Service (BeefPlan) already offers opportunities for within-farm progeny test comparisons of some reproductive and growth rate characters. But, for valid between-farm comparisons, the use of central performance test stations for measuring growth rate of beef bulls (Dalton, 1976) and central progeny tests (Carter, 1971; N.Z.D.B., 1973-4; Dalton and Gibson, 1974; Baker *et al.*, 1975) have been relied upon.

Central performance tests for beef bulls may suffer from pre-test environmental effects (Everitt *et al.*, 1975); they require a sequential programme of progeny testing to retain the interest of participant breeders and before extensive use can be made of "best bet" bulls through artificial breeding; and the bulls cannot be used while under test. Central progeny tests may also suffer from pre-test environmental influences when progeny are drawn from different environments (M.L.C., 1971), and are expensive to operate (Preston and Willis, 1970).

Multiple herd, on-farm progeny testing of beef bulls represents another course of development which, so far, has received little attention in New Zealand. The sire proving schemes of the dairy industry use on-farm contemporary comparisons, relying on extensive use of artificial breeding and herd testing, with random distribution of progeny of each sire among many herds. Comparable schemes may emerge for the beef industry in time but will be dependent upon much increased use of artificial breeding and performance recording.

Development of on-farm progeny testing for beef production needs to rely therefore on designed comparisons, with some degree of experimental control, so that bulls used naturally in single herds can be compared.

This paper illustrates some principles of on-farm progeny testing of beef sires by use of data drawn from trials designed for sire *breed* comparisons; and then offers a practical model for a scheme which could, if desired, be linked to central beef bull performance testing stations.

EXPERIMENTAL

The sire breed comparison trials, evaluating the performance of progeny of sires of several breeds, mated to Friesian cows, have been outlined previously (Everitt *et al.,* 1975; Dalton *et al.,* 1975).

Friesian, Hereford and Simmental sires (10 of each breed) were used in the 1972 mating season. The principles of allocation of semen of different bulls to individual farms followed those of an incomplete block design (Cox, 1958). Cows on each farm received inseminations from 5 of the 10 sires of each of the 3 sire breeds used. Semen from an individual sire was used on about half of the 21 dairy farms involved.

Steer weaners from these rearing farms were transferred to 9 grazing farms at 4 to 5 months of age, with animals drawn from 2 rearing farms going to the same grazing farm (Everitt *et al.,* 1975). Heifer weaners entered a centralized breeding programme (Dalton *et al.,* 1975).

The steers grazed together on each property, with liveweights being recorded quarterly, until slaughter started in March 1975 at the Horotiu works of the Auckland Farmers' Freezing Cooperative Ltd. Each carcass was weighed and processed to provide yields of edible meat, bone and excess fat as described elsewhere (Everitt and Evans, 1970).

Data were analysed by least squares analysis including the effects of breed, sire-within-breed, rearing farm, age of dam, and calf sex on birth weight; and of breed, sire-within-breed, grazing farm, rearing farm-within-grazing farm, and age for other performance characters. Liveweights-for-age were compared at 200, 400 and 550 days of age using the correction methods adopted for BeefPlan records. Statistical significance of variation between sires-within-breeds was assessed by comparison with residual variation. With this model the derived sire means were therefore adjusted for effects due the pre-transfer environment and differences in grazing farms.

The data used in this paper refer to 231 Simmental × Friesian (S × F) calves born in 1973 and, of these, 74 S × F steer progeny which had been slaughtered by July 1975.

RESULTS

Performance characters of the S × F progeny are summarized in Table 1.

Variation between sires was quite substantial and statistically significant in several characters of interest. For these traits, performance indexes, expressing the sire mean as a percentage of the breed mean, together with the ranking of each sire, are provided in Table 2.

In the case of birth weights, a lower value than the breed mean (100) has been converted to an index greater than 100; and a greater birth weight than the breed mean to an index of less than 100. This discriminates against higher than breed average birth weights because of the possible association between birth weight and calving difficulty. In all other characters, higher than breed average values have been converted to an index greater than 100.

Table 2 indicates the superiority of sire 66271 in those traits for which a significant sire-within-breed effect was recorded, but this sire group involved very few progeny (Table 1). The consistency of sire rankings at the different stages of growth, and in carcass weight, together with the relatively small variability in the percentage of edible meat, should also be noted.

Importantly, the analysis eliminated the pre-transfer rearing period effects on subsequent performance from sire comparisons. These exerted highly significant effects at all stages of growth measured, including carcass weight.

PROPOSED MODEL

A multiple-herd, on-farm progeny test of the type proposed as an extension of the system used in the breed evaluation trials involves three types of comparisons based on progeny performance.

(1) Among artificially bred (AB) bulls each of whose semen is used in the several co-operating herds.

(2) Between a naturally mated (NM) sire used on one farm and the AB sires.

(3) Between NM sires used in different herds.

The major constraint on the accuracy with which the relative breeding value of bulls can be determined arises from (3), because it is necessary to make comparisons of NM bulls indirectly, using the AB sires as references.

An example of a progeny test scheme for 6 farmers, each offering 90 cows, is given in Table 3. Forty-five of the cows would be mated to the farmer's own bull, and 15 cows to each of 3 AB sires. One of the latter might be a proven quality bull and the other two drawn from a central beef bull performance test, for example.

In contrast with the breed evaluation reported above, the proposed idealized scheme for detailed progeny testing would aim more at the use of the same AB sires on each farm.

The allocation of sires indicated in Table 3 represents an idealized situation and has been chosen to equate the accuracy of comparisons (2) and (3) above. If accurate testing of sires for calving difficulty was desired, then approximately 20 co-operating farms would be needed, given the same numbers of cows mated per sire as in Table 3.

Performance characters to be recorded should include, where possible:

All progeny

Birth weight
Calving difficulty
% live calves 48 h after birth
Liveweights at 200, 400 and 550 days

Steers

Slaughter liveweight and age
Carcass weight and export grade
Fat depth over "eye-muscle"
"Eye-muscle" area
Edible meat weight
Distribution of edible meat in primal cuts
Edible meat:bone ratio

A suitable choice of computing strategy (Henderson, 1973) would make the derivation of estimated sire means for selected

TABLE 1: SIMMENTAL SIRES — PERFORMANCE OF PROGENY

	N.Z. Dairy Board Sire Code No.												
	66212	*66213*	*66215*	*66271*	*66308*	*66312*	*66317*	*66319*	*66320*	*66321*	*All Sires*	*Signif. of Sires within Breed*	*Av. LSD*
No. single male and female calves born	19	26	22	13	27	30	23	27	21	23	231	—	—
Birth wt[1] (kg)	38.2	36.0	36.2	34.3	39.7	38.8	39.7	39.6	39.8	35.5	37.8	***	3.1
% Unassisted calvings	78.9	93.2	95.5	69.2	77.8	93.3	78.3	88.9	76.2	82.6	84.8	—	—
% Live calves[2]	94.7	96.2	95.5	92.3	92.6	96.7	91.3	92.6	100.0	95.7	94.8	—	—
Live wts[3] (kg) (No. steers)	(10)	(10)	(11)	(8)	(9)	(16)	(11)	(14)	(12)	(15)	(116)	—	—
200 days	139	149	139	148	135	142	141	136	138	140	131	ns	15
400 days	238	257	228	253	232	231	219	243	227	228	235	*	22
550 days	385	383	361	392	359	362	366	377	365	351	370	*	26
(No. steers)	(9)	(8)	(7)	(3)	(6)	(8)	(8)	(6)	(10)	(9)	(74)	—	—
640 days (slaughter)	444	440	419	473	402	412	412	440	410	410	426	*	37

Carcass wt[3] (kg)	222	225	212	240	198	206	204	216	211	207	214	*	21
% in carcass													
Edible meat	69.8	69.9	68.3	70.3	68.0	69.2	69.4	70.3	69.9	70.0	69.5	†	1.6
Bone	25.8	25.5	26.5	24.9	27.1	26.1	25.9	25.7	25.7	25.8	25.9	ns	1.5
Excess Fat	4.9	4.9	4.8	4.7	5.0	4.5	4.4	4.0	4.4	4.5	4.6	ns	1.0
High-priced edible meat cuts as % of total edible meat	40.0	40.0	40.0	40.0	40.0	40.0	40.0	39.9	40.2	40.1	40.0	ns	1.0
Edible meat:bone ratio	2.71	2.76	2.61	2.86	2.52	2.67	2.69	2.76	2.77	2.75	2.71	ns	0.11

[1] Least square means adjusted for farm, age of dam and calf sex effects.
[2] Calves alive 48 hr after birth as % of all single calves born.
[3] Least square means adjusted for grazing and rearing farms, and age, effects.
†$P < 0.10$

TABLE 2: SELECTED PERFORMANCE INDEXES[1] AND RANKINGS (IN PARENTHESES) FOR SIMMENTAL SIRES

Character	*N.Z. Dairy Board Sire Code No.* 66212	66213	66215	66271	66308	66312	66317	66319	66320	66321	*Av. LSD*[2] *for Index*
Birth weight	99 (5)	105 (3)	104 (4)	109 (1)	95 (7=)	97 (6)	95 (7=)	95 (7=)	95 (7=)	106 (2)	8
Live weights:											
400 days	101 (4)	109 (1)	97 (7=)	108 (2)	99 (5)	98 (6)	93 (10)	103 (3)	97 (7=)	97 (7=)	9
550 days	104 (2=)	104 (2=)	98 (7=)	106 (1)	97 (9)	98 (7=)	99 (5=)	102 (4)	99 (5)	95 (10)	7
640 days (slaughter)	104 (2)	103 (3=)	98 (5)	111 (1)	94 (10)	97 (6=)	97 (6=)	103 (3=)	96 (8=)	96 (8=)	9
Carcass weight	104 (3)	105 (2)	99 (5=)	112 (1)	93 (10)	96 (8)	95 (9)	101 (4)	99 (5=)	91 (7)	10
% Edible meat	100 (6=)	101 (1=)	98 (9=)	101 (1=)	98 (9=)	100 (6=)	100 (6=)	101 (1=)	101 (1=)	101 (1=)	2

[1] Individual sire means expressed as % of sire breed mean. Above average birth weight taken as a negative index; above average in all other characters as positive index.
[2] Average least significant difference for index.

TABLE 3: MODEL FOR ON-FARM PROGENY TEST

Sires	No. Cows Mated on Farm 1	2	3	4	5	6	Total Cows Mated
Reference Sires:							
AB 1	15	15	15	15	15	15	90
AB 2[1]	15	15	15	15	15	15	90
AB 3[1]	15	15	15	15	15	15	90
Natural Mating Sires:							
NM 1	45						45
NM 2		45					45
NM 3			45				45
NM 4				45			45
NM 5					45		45
NM 6						45	45
Total	90	90	90	90	90	90	540

[1] From Central Performance Test.

traits realistic in terms of computer time, even if a larger group of herds was involved in the scheme, while still eliminating the effect of rearing/grazing environment.

DISCUSSION

The sire breed comparative trials reported have provided data to illustrate some principles of a practical approach to development of multiple-herd, on-farm progeny testing for beef production. The objective of the trials was a *breed* comparison, necessarily involving several sires per breed and relatively few progeny per sire. Clearly, larger numbers of progeny per sire are necessary if the objective is a precise progeny test.

Some of the advantages of the proposed progeny test scheme are:

(1) Elimination of potential biases due to differences in rearing between groups of test animals.
(2) Distribution of cost between participating farmers.
(3) Active participation of farmers, on their own farms, with powerful extension functions for a national beef improvement programme.
(4) Inclusion of a breeders own NM bull in a test and comparison with NM sires on other farms.
(5) Ability to progeny test a large number of sires with appropriate modification of test design.
(6) Monitoring of possible genotype × environment interactions of AB sires.
(7) Encouragement to use artificial breeding.
(8) Logical extension of existing central performance tests for beef bulls.

The model proposed acknowledges the progress made overseas through operation of national on-farm systems of beef sire proving (Preston and Willis, 1970; B.I.F., 1975) and tempers theoretical requirements with the practical reality of working in relatively small herds.

Further details of the model, however, require consideration. For example: random selection of cows mated to each sire; equal opportunity for each progeny group; carcass evaluation procedures; incentives for bull owners and involvement of participants, especially commercial farmers; further use in artificial breeding, and control, of identified superior sires; and financial support for administrative, clerical, field, data analysis and publication aspects of the scheme.

Initiation of one or two pilot schemes, with national coordination, is advocated.

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