
THE PROCEEDINGS OF THE
NEW ZEALAND SOCIETY
OF
ANIMAL PRODUCTION
VOLUME 62 2002

Studies of alternative selection policies for the New Zealand sport horse

C.W. ROGERS AND G.A. WICKHAM

Department of Animal Science, Massey University, Palmerston North, New Zealand.

ABSTRACT

The present structure for breeding sport horses in New Zealand was summarised. Genetic progress is likely to be very slow due mainly to inaccurate selection of potential sires and a long generation interval. An industry objective was identified and alternative schemes to generate genetic response in the proposed breeding objective were analysed using deterministic models. Analyses of predicted benefits and costs were done.

Selection of colts by a one-day field test appeared to generate the most genetic progress and the best benefit-cost result of the single-stage sire-selection models. Station tests lasting 14-100 days also gave good genetic gains although it was assumed that high costs would greatly limit the number of 3 year old colts tested as potential sires in comparison with the one day field test. Selection on data generated in competitions restricted to young horses also generated a good rate of genetic gain.

Keywords: horses, breeding, selection plans.

INTRODUCTION

Sport horses have been defined as horses that are suitable for, and partake in, the Olympic equestrian sports of show-jumping, dressage and eventing (Tavernier 1990). This category can also include horses used for recreation activities such as leisure riding and hunting. At the time of the 1985 census approximately 35,000 horses were put in the recreation class compared with 25,000 workhorses (mainly farm hacks) 25,000 thoroughbreds and 16,000 standardbreds (harness racers).

Relatively few of the horses used as sport horses in New Zealand are bred for this role. Many used here and many of the older horses exported as sport horses were bred as potential racing thoroughbreds. The population bred for racing however is not selected for most traits desired in sport horses. In contrast, European countries have put in place breeding programmes aimed at genetic improvement for a sport horse objective. As gains accumulate from these programmes, racebred thoroughbreds will probably become inferior to the European horses in a sport horse role.

If New Zealand is to maintain its position in international equestrian competitions and continue to develop an export market for sport horses, the proportion that are purpose bred must increase. At present New Zealand sport horse breeding is making the transition from an amateur hobby activity toward an organised and professional industry. This transition has been fuelled by current overseas demand for the New Zealand sport horse, particularly the thoroughbred type of sport horse which is held in high esteem for eventing. This demand has increased returns to a level able to sustain specialised personel.

This paper reports some preliminary work toward developing a breeding policy for New Zealand sport horses.

MATERIALS AND METHODS

Several aspects of the development of a breeding plan were studied. These were:

1. the production system,
2. the objective,
3. appropriate selection criteria,
4. the design of evaluation systems

Data from the New Zealand Equestrian Federation, various breed societies and discussion with breeders provided information on the production system. There were little data to help establish economic weights applicable to the New Zealand sport horse industry. The weights of the selection objective were chosen subjectively after discussion with breeders and people involved in sport horse exporting.

Six possible evaluation systems were identified. These systems were based on selection programmes currently used for European sport horse selection. Deterministic models were created to compare the genetic gains achieved from potential schemes and these were compared with gains likely being achieved with the present structure. Most emphasis was on the design of the sire selection system. Because of the high selection intensity that can be achieved in selection of sires this is the pathway that generates most of the improvement.

In construction of these models many assumptions had to be made and these could only be chosen subjectively after the examination of data thought to be appropriate. The heritabilities and correlations used (Table 1) were chiefly based on those generated from data collected during station testing of European warmbloods. Since the horses are often from fairly uniform environments the heritabilities might be higher than those that will apply to New Zealand populations. The phenotypic standard deviation of the traits was assumed to be unity.

TABLE 1: Genetic and phenotypic values used in calculating correlation between the selection index used in each model and the objective (r_{TI}).

Traits	Mov.	Confo.	Jump.	Ride.	Temp.	Bunt.
Movement	0.36	0.50	0.00	0.47	0.59	0.00
Conformation	0.75	0.30	0.20	0.30	0.20	0.00
Jumping	0.25	0.45	0.25	0.10	0.50	0.00
Rideability	0.53	0.53	0.28	0.25	0.70	0.00
Temperament	0.31	0.31	0.36	0.53	0.16	0.00
Bunt	0.10	0.00	0.00	0.00	0.00	0.30

Heritabilities on the diagonal, genetic correlations above and phenotypic correlations below.

Estimates chosen after considering previously published values such as those of Bade *et al.*(1975), Bruns *et al.*(1985), Huizinga *et al.* (1990,1991) and Preisinga *et al.* (1992).

Benefit-cost analysis was performed to provide a measure of genetic improvement per unit cost. The costs considered were only those of the evaluation system, operated without charging the owners. There are other benefits and costs to owners which will vary according to the system but which have not been included in the calculations.

RESULTS AND DISCUSSION

The production system

Many New Zealand breeders produce horses for their own use. These breeders usually have only one or two broodmares. Those who breed sport horses for sale have larger herds. Selling broken and lightly schooled 3-4 year olds appear to offer breeders the best return (A.Vallance personal communication).

The major market is to local riders who are becoming prepared to pay higher prices for purpose-bred sport horses even though there are many race-bred thoroughbreds available at low cost. There is also a growing and more-lucrative export market. For the export market, the majority of buyers want to purchase either top proven competition horses or young horses (4-6 years) that are well schooled with the potential to be above average (Rogers 1991, Scott 1992, A.Magnusson personal communication).

Derivation of a breeding objective and index

The derivation of the breeding objective is one of the most important steps in the development of genetic improvement programmes. The question of who is to benefit from the improvement must be examined and then the traits to be improved identified. In this study the perspective taken was that of the commercial sport horse breeder, however benefits are also likely to accrue to the hobby breeder and future riders. In simple form the objective proposed was not greatly different to those proposed for a number of the European sport horse breeds, that being the improvement of the complex of traits needed for success in showjumping, dressage, and eventing.

When establishing the objective of the overall breeding and production system it is desirable to consider other characteristics that may not directly relate to competition success. Some such as willingness to work and ease of handling reduce the time and stress involved in training. Others such as fertility, efficient feed utilization and durability minimise other costs. However the lack of genetic parameters meant that some traits could not be included in the selection models.

The selection objective used in this study was;

$$H = 48g_1 + 216_2 + 328g_3 + 282g_4 + 51g_5.$$

where g_1-g_5 are the genotypes for bunt (attractive white markings), conformation, jumping, rideability, and temperament respectively and the weightings equate to $ per unit of phenotypic standard deviation.

The objective weights were initially derived from the subjective estimates and so may contain significant bias. Smith (1978) suggested that errors in the economic weights have to be fairly large before they have much impact on the responses to selection.

When only jumping performance and rideability were included as selection criteria, the genetic gain was only 7% less than when all traits were included.

Selection Strategies

1. The present system

At present the majority of the broodmares in the sport horse breeding population are race-bred thoroughbreds. Some sport horse broodmares were bred as farm hacks. Only about 20% were bred as sport horses but this is likely to grow in the near future.

Of the stallions, 60-70% were bred as racing thoroughbreds. There is a small number of warmblood stallions that have been imported from Europe after they have been through one of the central performance tests. Some registered sires are crossbred.

This gene pool is probably one of the advantages. A proportion of racebred thoroughbreds make excellent sport horses. Gleissner (1989) found that horses with a large proportion of thoroughbred ancestry and of thoroughbred type were most sucessful in international showjumping competitions. Burzcyk (1989) found that part-thoroughbred horses were more successful in dressage than those of pure warmblood ancestry.

Selection at present makes little use of records. Conformation and movement are the main criteria. Relationship to prominent competition horses is also considered. This use of family selection may tend to accentuate the long generation interval (G.I. = 16.9yrs).

2. The normal horse competition model (NHC)

This model was very similar to the present system but involved some simple changes to the breeding structure to make better use of competition records, to increase the intensity of selection and to reduce the generation interval. However stallions were assessed on their own or their progeny's performance in normal competitions and few horses are mature enough to achieve much before 5 years so that the generation interval was still long. Gains predicted with this model were about double those of the present system but, at about 0.015 of a standard deviation of the objective per year, they were still well behind gains for models that selected effectively at an earlier age.

3. The young horse competition model (YHC)

In France, a prestigious series of competitions where 3, 4, 5, and 6 year old horses compete within their own age, is held (Bour 1990, Tavernier 1990). The model assumed 244 colts of each age competed in similar competitions in New Zealand and the best were selected on the competition data. Since more colts were likely to be left entire to these ages and since the generation interval could be kept to a lower level, gains were considerably better than with the NHC model but the number ridden in competition would have to increase markedly if the gains predicted by the model are to be realised in practice.

4. The one day riding quality test model (ODRQT)

This model is based on a system used in Sweden for mare evaluation. In the present model it involves evaluation of recently-broken 3-year-old colts during a testing day.

The traits scored were proposed to be:
conformation,
movement (walk, trot, canter),
rideability / temperament (ridden judgement) and
jumping performance (without a rider).

This evaluation procedure offered the advantage of a low generation interval. Costs were also low so that similar numbers are likely to be evaluated as in the YHC. From relevant published genetic parameters it appeared that selection would be more accurate than that based on YHC data (correlation of the index to the objective 0.27). As shown in table 2, if only 29 top colts were used of the 244 it was assumed would be tested, this model appeared to be the most successful. However there must be worries about how appropriate the genetic parameters were for a New Zealand population.

5. The 2-week long station test model (2w CPT)

The key elements of most European sport horse genetic improvement programmes are the central performance tests (station tests) for evaluating colts. Two week tests are the shortest; the longest are for 11 months (Ohlsson and Philipsson,1992). During these tests the horses are schooled in uniform ways to minimise the effects of the pre-test environment and then evaluated. Table 2 shows that even though the 2w CPT was more accurate than the ODRQT, its model did not perform so well. The problem was the reduced selection intensity since it was assumed that costs would limit the number of colts tested to 73 with 29 needed for breeding.

6. The repeated week-long test (3*1w CPT)

In Sweden, warmblood colts are tested for a week on 3 occasions at 6month intervals. In the model it was assumed that the 73 colts starting in the first round of testing completed all 3 stages. In this form the model had little to recommend it. In practice, some would be progressively eliminated so that costs might be lower.

7. The 100 day test (100d CPT)

This is the most common colt testing format in Europe. It provides considerable scope for ironing out the effects of the pre-test environment and consequently it was the most accurate. However it is very costly. This is not such a factor when horse prices are high and many of the costs are met by the state, as in Germany. However in New Zealand it is likely to limit the number of colts tested greatly. In the model it was assumed that only 49 colts would be tested annually and 29 of these would be required for breeding. As a consequence of this low selection intensity the genetic gains appear lower than from the ODRQT (0.024 vs 0.026). Since many of the genetic parameter estimates available have been generated from data collected in 100d tests the estimates from this model are likely to be more accurate than those for the ODRQT model. However, sensitivity analysis indicated that changes to the genetic parameters are unlikely to overcome the advantages from the higher intensity of selection assumed for the ODRQT model.

Expansion of sire selection to 2 stages to include the ODRQT and then the 2w CPT for the top colts from the ODRQT would generate even greater genetic gain (0.029 standard deviation units/ yr) but it may be difficult to get industry acceptance.

If a modified ODRQT was used to select dams to breed potential sires, more gain could be generated. In this proposed evaluation procedure a temperament score replaced the rideability score so that the mares did not have to be broken in. When superimposed on the ODRQT for colts the total genetic gain became 0.028 standard deviation units per year. A combination of the ODRQT for dams and the 2w CPT for colts gave estimated genetic gains of 0.032 units.

TABLE 2: Overview of the accuracy of selection (r_{TI}), generation interval, selection intensity and, genetic gains of the models tested.

MODEL	r_{TI}	Generation interval	Colts used/tested	Genetic Gain (σ/y)
Present	0.04	16.9	43/244	0.003
NHC	0.18	19.2	29/49	0.010
YHC	0.18	13.1	29/244	0.019
ODRQT	0.27	10.9	29/244	0.026
2 w CPT	0.32	12.7	29/73	0.024
3*w CPT	0.32	12.7	29/73	0.024
100d CPT	0.45	12.7	29/49	0.024

Benefit-Cost Analysis

Table 3 summarises the results of benefit-cost analysis of the models.

When interpreting these figures the subjective nature of the estimates of the value of benefits must be emphasised. As well as genetic benefits these also include estimates of the value of secondary benefits such as those arising from the confidence of overseas buyers in the ability of New Zealand horses. These secondary benefits cannot be predicted with any degree of reliability.

The rate of return to the ODRQT, YHC, 2 w CPT, 3*1w CPT and 100d CPT all looked extremely favourable and the limited reliability of the assumptions means that it is not a simple choice between them.

CONCLUSIONS

The implementation of one of several selection methods for sport horses appears to offer substantial benefits for the

TABLE 3: Results of the benefit-cost analysis of the single-stage selection models.

Model	value of benefits ($)[1] genetic	secondary	cost($)[2]	NPV($)[3]	IRR(%)[4]
Present	60,000	8,000	27,500	-31,982	—
NHC	200,000	40,000	27,500	510,362	40.9
YHC	360,000	300,000	51,000	1,620,695	5.5
ODRQT	520,000	180,000	59,000	1,692,735	54.5
2 w CPT	480,000	140,000	75,000	1,396,748	48.2
3*1w CPT	480,000	80,000	78,000	1,148,092	42.3
100d CPT	480,000	140,000	115,000	1,089,701	36.1

[1] The annual benefits of the testing system in 1992 $NZ.
[2] The annual cost of the testing programme in 1992 $NZ.
[3] Nett present value, future benefits-costs discounted (15%) back to the present.
[4] The internal rate of return on expenses of the testing system.

New Zealand sport horse breeding industry. Within the limitations of this study the ODRQT looks the testing procedure to implement initially. It appears to offer reasonable efficiency of genetic improvement and significant secondary benefits. It will be easier to implement than the more-costly tests. However further research on other alternatives, particularly multi-stage selection plans, is desirable.

REFERENCES

Bade, B.; Glodeck, P.; Schormann, H. 1975. Die Entwicklung von Selektionskriterien fur die Reitpferdezucht. 2.Genetische Parameter fur Kriterien der Nachkommenprufung von Hengsten im Feld. *Zuchtungskunde* **47(2):** 67-77

Bour, B. 1990. The approach to appraising young horses in France. In: *Horse Breeding in France.* B.Langlois, ed. C.E.R.E.O.P.A. F.E.Z.-E.A.A.P Publication.

Bruns, E.; Rauis, B.; Bade, B. 1985. Die Entwicklung von Selektionskriterien fur die Reitpferdezucht.5. Phanotypische und genetische Parameter und Selektionsindices fur eigenleistungsgeprufte Hengste. *Zuchtungskunde* **57(3):** 172-182

Burczyk, G. 1989. Beziehungen zwischen Korpermassen und Leistungparametern bei Dressurpferden. *D.V.M diss. Ludwig-Maximillians-Universitat. Munchen.*

Gleissner, S. 1989. Beziehungen zwischen Korpermassen und Leistungsparametern bei Springferden. *D.V.M diss. Ludwig-Maximillians-Universitat. Munchen.*

Huizinga, H.A.; Boukamp, M.; Smolders, G. 1990. Estimated parameters of field performance testing of mares from the Dutch Warmblood riding horse population. *Livestock Production Science,* **26:**291-299.

Huizinga, H.A; Van Der Werf, J.H.J; Korver, S; Van Der Meij, G.J.W. 1991. Stationary performance testing of stallions from the Dutch Warmblood riding horse population.1. Estimated genetic parameters of scored traits and the genetic relation with dressage and jumping competition from offspring of breeding stallions. *Livestock Production Science* **27:**231-244.

Ohlsson, L.; Philipsson, J. 1992. Review of performance testing procedures for stallions and mares of riding horse breeds. *43rd Annual Meeting of the EAAP* Madrid 1992.

Preisinger, R.; Wilkens, J.; Kalm, E. 1991. Estimation of genetic parameters and breeding values for conformation traits for foals and mares in the Trakehner population and their practical implications. *Livestock Production Science,* **29:** 77-86.

Rogers, C.W. 1991. Young horse competitions: a discussion paper. *New Zealand Horse Society Bulletin* April 1991 6-7.

Scott, W.W. 1992. Presidents message. *New Zealand Equestrian Federation Bulletin* No 197: 2.

Smith, C. 1978. The effect of inflation and form of investment in farm livestock. *Animal Production* **26:** 101-110

Tavernier, A. 1990. Performance and BLUP procedure: new ways in breeding race and sport horses. In: *Horse breeding in France* B. Langlois, ed. C.E.R.E.O.P.A. F.E.Z.-E.A.A.P. Publication