Indices for Super-Traits Versus Total Merit Index: Theoretical Considerations and Practical Benefits

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The Total-Index

In Table 1 breeding goal traits, which are of interest in dairy cattle breeding, are summarized by Groen (1996). Relevant production traits are milk fat and milk protein, milk non fat and non protein (carrier), milk quality and a set of beef production traits. In addition functional traits are of interest from an economic or biological view point in order to support efficient production.

The number of breeding goal traits in Table 1 to select for is 18. The breeding goal or total aggregate genotype is then defined as the sum of true breeding values for these 18 traits, weighted by their marginal economic values. However some breeding goal traits, like the trait 'showing heat', are not recorded and not known in central data bases. Therefore indirect traits have to be used for selection. The number of direct and indirect traits for which data are available and can be used for breeding value estimation is more than 20. By use of selection index theory a selection index can be constructed. Such an index, a total index, is the sum of estimated breeding values for all traits for a specific bull, weighted properly for a maximum genetic gain in the total aggregate genotype.

Undesired properties of the total index

Selections indices constructed with use of the classical selection index theory, have proved to be most efficient, if:

- marginal economic values are precisely known;
- genetic parameters are known without error.

This is often not the case. In practice marginal economic values for functional traits may be not precisely known, especially for some functional traits where farm management circumstances or production systems may influence marginal economic values. In addition genetic correlations of some functional traits with production traits are not known or known with a high standard error. Moreover genetic correlations may change in time by selection.

Sensivity analyses have been used to estimate the effect of using alternative economic values or other sets of genetic parameters. The robustness of the index is then tested. However, if economic values differ between farms it would be better to have different sets of selection indices.

Another problem with a total index may be the number of traits in the index and the effect of one trait on the index value. It is known that the number of traits in a selection index should be limited. If not, problems may be arise with calculating the index weights or index weights may get unrealistic values. In addition monitoring of the selection process may be difficult. Two bulls with a total different genetic make up may have the same total index value.

Selection indices for super traits

The uncertainty about marginal economic values and on genetic correlations is highest when super traits have to be weighted in one index. Super traits or sub indices are aggregate basic traits which are highly

correlated and which may be of interest from a breeders view point. A list of super traits is in Table 2. Within super traits problems with uncertain marginal economic values and genetic correlations among the basic traits are minimized. Examples of super traits are INEL, INET, RZW etc for milk production.

The super traits listed in Table 2 are of interest in dairy cattle breeding. Number of super traits is 8, so that only breeding values for these super traits may be published to farmers. The weighting of super traits for final selection can differ from farm to farm or from cow to cow. Computer programs are available to assist in that. The weigthing may be based on desired genetic progress or on marginal economic weights which may be derived at farm level. In addition genetic progress may be more monitored.

For farmers the use of super traits may be very useful. For the AI industry, information on estimated breeding values for all basic traits and for all super traits is useful. Breeding values for basic traits can be used in order to have more control over the selection process by the AI industry or to monitor the genetic progress for some basic traits.

Discussion

Advantages of the use of super traits is the summary of all breeding values for a bull to a limited number of key-traits. At the end the publication of proofs to most farmers may be more simpel, without any loss in flexibility. In the Netherlands for example there is a group farmers who certainly are not interested in having breeding values for beef characteristics in a total index, while other farmers certainly have. The same discussion is with fertility. Therefore a total index will increase discussion on the index itself, which traits should be in the index and which not, apart from the undesired properties which are mentioned already. Advantages of selection index theory are used in super traits. Disadvantages are avoided.

References

Groen, A. 1996. Lecture for Round breeders Table, March 5 and 6, 1996, Papendal, The Netherlands.

Table 1. Summary of breeding goal traits and traits to be used in indirect selection in dairy cattle breeding (Groen, 1996)

Breeding goal traits		Index traits for indirect selection
Production traits		
Milk	Carrier	
	Fat	
	Protein	
	Milk quality	
Beef	Carcass weight	
	Lean meat yield	
	Meat quality	
Functional traits		
Efficiency	Body weight	
	Feed intake capacity	
Fertility	Showing heat	
	Pregnancy rate	Non-Return, interval first insemination - conception, number of inseminations per pregnancy
	Calving ease	Rump angle, rump width
	Stillbirth	
Health	General	Longivity, persistency
	Mastitis	SCC, udder depth, fore udder attachment, teat placement/lenght, milking speed
	Feet and legs	Rear legs set, claw diagonal
	Other diseases	
Milkability	Milking speed	
	Temperament	

Table 2. A proposal for definition of supertraits to be used in dairy cattle breeding

Supertrait	Traits in index for this supertrait
Efficiency of Milk production	Carrier (milk), fat, protein, milk quality, linear scored type traits, body measurements, body weight, persistency
Efficiency of beef production	Carcass weight, Lean meat yield, Meat quality
Fertility	Non-Return, interval first insemination - conception, number of inseminations per pregnancy
Calving ease	Still birth, Rump angle
Health general	Longevity, persistency
Udder health	SCC, udder depth, fore udder attachment, teat placement/length, milking speed
Feet and legs	Rear legs set, claw diagonal
Milkability	Milking speed, temperament during milking