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Lifetime Production Index (LP Index)

▪ Introduction

A cow's lifetime production is determined by her milk production and by the number of days she is in milk production. When the genetic capacity for lifetime production must be improved, the selection of the right bull is important. To determine a bull's genetic potential for lifetime production, knowledge about the potential for production and longevity are important as well. Breeding values are already available for both components. However, if you wish to determine lifetime production in more detail, the rate of maturity, persistency and calving interval play a role as well. Breeding values are available for the first two factors as well.
A lifetime production index for bulls can be derived from existing breeding values and information.

The aim of the lifetime production index for bulls is to express the genetic potential for lifetime production, which in essence is calculated from the breeding values for production and longevity.

▪ Background of the calculation

When the breeding value for lifetime production is derived from existing breeding values, production breeding values, rate of maturity, longevity and calving interval qualify as key index figures.

The breeding value longevity of a bull indicates the average number of production days that his daughters spend more or less on a farm from the first calving compared to the population. Thus, the breeding value longevity indicates the differences between daughter groups with regard to the number of days that the daughters are actually in lactation. Of course, half of the breeding value is passed on to the daughters. So half the difference in breeding value that is shown in bulls can be found in the performance of the daughter groups.
The breeding value longevity is used to determine the difference in the percentage of survival per day of life of a bull's daughter group compared to the population. Each bull has his own survival curve. If the longevity breeding value of a bull is high, then the probability of survival per day of a daughter of this bull is increased. Cows are followed for 11 lactations in this manner.

For the genetic potential for production, the 305-day production breeding values for milk, fat and protein are available. To take into account the difference in genetic potential, for the first three lactations, the genetic lactation curves for milk, fat and protein yield from the test day model are used. Breeding values are available from day 5 through 335. Lactation curves for later lactations are based on the shape of the curve in lactation 3, using a lactation correction factor. With this lactation correction factor the effect of age on production can be taken into account.
Using the genetic curves, differences in persistency and rate of maturity can be taken into account.
The rate of maturity in the lifetime production breeding value is determined by using the individual breeding values for lactations 1, 2 and 3. When a bull's daughters show a higher rate of maturity than average, then this is clear from the three individual breeding values. Currently, in the test day model (milk production breeding value estimation), the breeding value rate of maturity is also determined from the difference in production realised in lactation 3 compared to the production in lactation 1. The production in lactation 3 is used to estimate the production in lactation 4 and higher, using the general age factors to get from lactation 3 to lactation 4 or higher. It is assumed that daughters do not show any further production development after lactation 3 compared to the whole population. So the rate of maturity shown by a daughter group is based on the rate of maturity from lactation 1 to lactation 3 as already shown.

For lactations longer than 305 days, the genetic potential for the days from day 305 can be predicted using the 305-day curves by fitting a function to the breeding values of the daily productions.

The average length of lactation of a daughter group is determined by the calving interval. The average calving interval in the population is currently 418 days. With an average dry period of 60 days, this results in an average length of lactation in the population of 358 days. For each bull, the average length of lactation of the daughter group can be determined based on his breeding value for calving interval.

Based on a bull's survival curve and lactation curves, the quantity of milk produced per day during the whole lifetime of a daughtergroup is determined.
The length of lactation is bull-dependent, but the dry period is constant for every bull.
The result of the addition of all daily productions is a breeding value for lifetime production for milk, fat and protein production.

For bulls without any known genetic lactation curves, because they have no daughters in milk production in the Netherlands and Flanders, the population lactation curve is used. Based on this population-lactation curve and the breeding value for production, the genetic potential per day is determined. This situation applies to both bulls tested abroad and genomic bulls.

The lifetime production index that is published for bulls is based on the lifetime production values for fat and protein, with weighting given to the current INET factors. The lifetime production index indicates a cow's lifetime yield in terms of milk production minus feed costs, all expressed in euros. It is *the* combination of longevity and milk production, providing insight into the extent to which the production of milk depends on longevity, when the cow's whole lifetime is taken into account.

The correlations between lifetime production and the traits are shown in Table 1. The correlations are based on breeding values of a group of bulls.

Table 1 Correlation between breeding values for black-and-white bulls born in 2004 for the traits used in the lifetime production index. Lt stands for the lifetime production of the trait.

	NVI	CI	long	milk	fat	prot	lt milk	lt fat	lt prot	lt Inet
NVI		0.45	0.77	0.41	0.60	0.55	0.80	0.84	0.82	0.83
CI	0.45		0.36	-0.19	-0.04	-0.12	0.29	0.33	0.31	0.32
long	0.77	0.36		0.31	0.36	0.41	0.94	0.95	0.96	0.97
milk	0.41	-0.19	0.31		0.45	0.82	0.59	0.39	0.49	0.44
fat	0.60	-0.04	0.36	0.45		0.65	0.44	0.60	0.48	0.54
prot	0.55	-0.12	0.41	0.82	0.65		0.61	0.54	0.63	0.60
lt milk	0.80	0.29	0.94	0.59	0.44	0.61		0.94	0.98	0.96
lt fat	0.84	0.33	0.95	0.39	0.60	0.54	0.94		0.97	0.99
lt prot	0.82	0.31	0.96	0.49	0.48	0.63	0.98	0.97		0.99
lt Inet	0.83	0.32	0.97	0.44	0.54	0.60	0.96	0.99	0.99	

CI is calving interval, long is longevity, prot is protein

▪ Base and base differences

See chapter ‘Bases for breeding values and base differences’.

▪ Publication requirements

See chapter ‘Publication rules sires’.