The Effect of More Health Traits in DPS on Economic Selection

G. de Jong and A.G.F. Harbers
CR Delta, P.O. Box 454, 6800 AL Arnhem, The Netherlands
Jong.G@CR-Delta.nl

1. Introduction

Dairy farmers are continuously looking for dairy cows they love to milk and give good profit. The breeding goal for dairy cows in the Netherlands can shortly be described as: healthy cows which produce a lot of milk and protein during a long time. Actually farmers aimfor breeding cows which produce a lot of milk with the lowest number of problems.

This means that the Dutch farmer wants to have high yields for milk, fat and protein, which was supported by developing an index combining these three traits, Inet. In Inet milk, fat and protein yield are weighted based on economic values and can be computed as Inet = -.15*milk + 2*fat +12*protein. To be able to select for cows which produce for a long time, a breeding value for durability was introduced in 1999. This durability index (DU) is a tool for selection on herd life of daughters by decreasing involuntary culling. By selecting bulls on DU farmers can breed for cows that last longer, which also have less problems during their life. It also can be considered as an index for likability or workability. To improve the selection and ranking of bulls, Inet and DU were combined in the Durable Performance Sum (DPS) in 1999. While Inet shows the net profit per lactation on heifer level when selecting on milk production traits, DU was weighted in DPS with the net profit due to increase herd life by reduction of involuntary culling.

To rank bulls more profitably on economics and to provide farmers with a more complete index, DPS was extended in August 2001 with four traits: udder health, fertility, calving ease and maternal calving performance. These four traits had to be weighted in the new DPS index with their effects on profitability or labour income other than production and herd life, as Inet and DU were already accounting for this.

This paper describes the new weights for the traits in DPS and the effect on selection when using the new DPS.

2. Development of new DPS

The DPS, in use up to August 2001, was based on Inet and DU and was computed as : DPS = Inet + 15* (DU -100), where Inet and DU are breeding values. The result is a DPS value in Dutch guilders (NLG), expressed on the level of a heifer lactation. The economic value for DU is 67.5 guilders per genetic standard deviation (Vollema et al., 2000). The new DPS, in use since August 2001, was extended with the traits : udder health, fertility, calving ease and maternal calving performance.

Udder health

The breeding value for udder health is a selection tool to increase the resistance against clinical mastitis. This breeding value is based on the mean for incidence of mastitis per cow per year (0.26 cases per cow per year), and is expressed as a relative breeding value. As no direct observations for clinical mastitis are not available, the index is based on predictors somatic cell score, udder depth, fore udder attachment, teat length and milking speed (De Jong and Lansbergen, 1996).

For determining the weighting factor for udder health in DPS, the costs of clinical mastitis need to be calculated. The costs for mastitis include reduced milk production, increased culling of animal, treatment costs and milk which cannot be used for human consumption. When deriving the economic value for udder health, cost for loss of milk production and culling should not be taken into account as this is already discounted via Inet and DU. Average cost of one mastitis case is NLG 180,- for treatment and non-deliverable milk (De Vos, 1998). The economic value of one genetic standard deviation is NLG 12.33. As one genetic standard deviation is 4.5 breeding value points, one breeding value point has an economic value of NLG 2.74 per lactation. (Table 1). One point udder health index results in 0.75 less mastitis cases in the bulls' daughter group per lactation.

Fertility

Fertility is for farmers extremely important, especially when seasonal calving is applied. But even without seasonal calving fertility gets increased attention from the farmers as they face more problems with cows' fertility. A cow with good fertility should show heat in time and should be pregnant after first insemination. On population base interval between calving and first insemination and non-return before day 56 are important tools to improve fertility. This will result in a decreased calving interval, the main farmers' breeding goal for fertility. Farmers save costs by reducing calving interval and reducing the number of inseminations per cow. Per day calving interval reduction on average during the period of 11-17 months NLG 1.58 can be saved. The economic loss of returning cows to service exist of cost for extra semen (NLG 16.00), labour of farmer (10 minutes, which equals to NLG 6.00), and semen (NLD 23.00 per dose) resulting in a total cost of NLG 45.00 for one extra insemination. One percent higher non-return equals to an economic value of NLG 0.45 per percentage per cow per year.

The fertility index, which is calculated from interval between calving and first insemination and non-return before day 56, has a breeding goal to improve calving interval and non-return. The weighting factor for one point relative breeding value in DPS is NLG 2.84. When a bull has one point higher breeding value, expressed on a scale with mean 100 and genetic standard deviation 4.5, his daughters will have a 0.5 day shorter calving interval and 0.1 percent higher non-return.

Calving ease and maternal calving performance

An AI-bull receives two breeding values on the performance of his offspring during calving. The first one is the index for calving ease which determines how easy calves of a certain bull are born. The second one is the maternal calving performance index which shows how easy daughters of a certain bull give birth to their calves. Both indexes are presented as relative breeding values, with a mean of 100 and a genetic standard deviation of 4.5. Calving ease and maternal calving performance have a negative genetic correlation of about -0.5. This means that in general calving ease bulls have on average low values, so more problems, with maternal calving ease.

Veterinary costs, extra labour of farmer and loss of calf are costs taken into account, when deriving an economic weight for use in DPS and which are due to difficult calving. Effect of a difficult calving on milk production, culling of cow or fertility are expressed in breeding values for milk production, durability and fertility and costs are already taken care of as these traits are already in DPS. Groen et al. (1995) presented an economic value of NLG 1.33 per cow per year per percent extra calving difficulty for veterinary costs, extra labour of farmer and loss of calf.

One genetic standard deviation in second and higher parity cows for calving ease is 6.4 percent, and for maternal calving ease 4.7 percent. For heifers these percentages are respectively 10.8 percent and 7.9 percent. When taking into account the distribution of number of first parity calvings and later parity calvings, which are in the ratio of 1 to 2, the weighted genetic standard deviations for the two traits are 7.9 percent for calving ease and 5.8 percent for maternal calving performance, respectively.

From this the derived economic value for one point breeding value calving ease is NLG 2.33 per cow per year and for maternal calving performance NLG 1.71 per cow per year.

New DPS

The new health traits in the DPS result in a DPS formula as follows:

DPS = Inet +
15 * (Durability – 100) +
2,74 * (Udder Health – 100) +
2,84 * (Fertility – 100) +
2,33 * (Calving Ease – 100) +
1,71 * (Maternal Calving Process – 100)

Relative weights

When looking at the relative weights for the different traits in the DPS, three groups of traits can be determined: production (Inet), durability (DU) and health traits. The weighting of production versus other traits is 57 percent for

production and 43 percent for durability and health traits together (Figure 1). In the former DPS the ratio of Inet and DU was 2:1, the result of economic value of one genetic standard deviation Inet (NLG 148) and DU (NLG 67.5). So the influence of production is decreased now with 10 percent points.

Durability and health traits have quite a bit of overlap when looking at separate traits. Somatic cell score is used as predictor in DU and in udder health index. The total weight of udder health when adding the weight for udder health index, and the predictive value of somatic cell score and udder traits in DU, is 11 percent. Six percent from prediction of durability and five percent due to extra economic value of udder health. Fertility has a relative value of 7 percent in the DPS. Calving ease and maternal calving performance have respectively 4 and 7 percent weight in the DPS index. The last health trait feet and legs weighs for 3 percent in DPS, and is used solely as predictor for DU.

Effect on selection

The correlation between aggregate genotype of the new and former DPS is 0.99 (Table 2). This means that not to much reranking occured among bulls when the new DPS was introduced. But still some bulls changed more than NLG 30. The genetic standard deviation of the new DPS is 164 guilders, whereas the DPS consisting of INET and DU had a genetic standard deviation of 163. More changes were found when DPS was introduced and bulls were ranked on DPS instead of Inet. The correlation between aggregate genotype of former DPS and Inet was 0.91.

DPS us computed on regular basis without taking into account the correlations between the traits. When applying correlations the standard deviation of aggregate genotype of the new DPS is NLG 160 instead of 163, when not using genetic correlations.

The reliability of a bulls' DPS at the moment information is available at the beginning of second lactation for the first crop of daughters, with on average 120 daughters having started a first lactation, is 0.87. The response when selecting bulls on the new DPS at that moment is for Inet NLG 129 and for durability and health traits combined NLG 19 (Table 3). This means that when bulls are selected at that moment on DPS 87 percent of the economic gain is due to improvement of milk production. In case the breeding values for all traits of a bull are known with 100 percent reliability, 81 percent of the economic response due to selection on DPS is from Inet, and 19 percent from durability and health.

When selecting on the new DPS the response in Inet is 3 percent lower compared to the former DPS (Table 3). But response on durability is improved with 16 percent. The response on udder health and fertility is still negative but improved with respectively 50 percent and 28 percent by using the new DPS instead of the former DPS. Selection on the new DPS reduces the negative effects of selection for production on udder health and fertility. Moreover, there is a small improvement in calving ease and maternal calving ease.

DPS can be used as a tool to quickly select bulls which give most economic daughters for the farmer. The new index supports the breeding goal better than ever before: healthy cows producing a lot of milk and protein during a long time.

Conclusion

- The new DPS is more complete, after adding extra indexes of health traits. It guarantees better that when a farmer is using the DPS to select bulls, he gets high yielding cow for production which can produce for a long time with a reduction in problems.

- The weighting of all traits is only based on economics.

- The influence of milk production traits in DPS is reduced from 67 percent to 57 percent.

- The influence of durability and health in DPS is increased from 33 to 43 percent.

- Reranking of bulls was much larger when DPS was introduced to replace Inet as ranking tool for bulls, than now with adding extra breeding values of health traits to the DPS index. The addition of four health traits can be seen as further fine tuning of DPS to optimise economic gain for the dairy farmer.

Literature

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Table 1. Economic values for traits used in DPS

Trait	Unit	genet. st.dev.	econ. value per unit	econ. value per gen.stdev.
Milk	kg	482	-0.15	-72.30
Fat	kg	19.75	2	39.5
Protein	kg	14.64	12	175.68
Inet	NLG	148	1	148
Durability	BV point	4.5	15	67.5
Udder health	BV point	4.5	2.74	12.33
Fertility	BV point	4.5	2.84	12.78
Calving ease	BV point	4.5	2.33	10.49
Maternal calving ease	BV point	4.5	1.71	7.70

Table 2. Standard deviation of aggregate genotype of Inet, original DPS (DPS_1999, introduced in 1999) and new DPS (DPS_2001, introduced in 2001) and the correlation between aggregate genotypes of the three indexes. Correlations between traits in index are assumed te be zero

	Inet	DPS_1999	DPS_2001	st.dev.(NLG)
Inet	1.00	0.91	0.90	148
DPS_1999		1.00	0.99	163
DPS_2001			1.00	164

Table 3. Response (NLG) in traits when using Inet, DPS_1999 and DPS_2001 to select sires in case breeding values are known with 100 percent reliability. Between brackets are responses when bulls are selected based on information available at the beginning of second lactation of first crop of daughters. Correlated response in traits are underlined

Trait	Inet	DPS_1999	DPS_2001
Inet	148.0 (142.1)	134.7 (133.2)	129.9 (129.1)
DU	0.0 (0.0)	27.9 (18.6)	31.3 (21.6)
Udder health	-2.5 (-2.4)	-1.0 (-1.4)	-0.0 (-0.7)
Fertility	-5.1 (-4.9)	-3.1 (-3.6)	-2.1 (-2.8)
Calving ease	0.0 (0.0)	0.0 (0.0)	0.4 (0.4)
Maternal calving perf.	0.0 (0.0)	0.0 (0.0)	0.1 (0.0)
Respons			
index	148.0 (142.1)	162.6 (151.8)	159.7 (147.6)
including correlated traits	140.4 (134.8)	158.5 (146.8)	159.7 (147.6)

For calculation response genetic correlations were assumed between Inet and fertility of -0.4, Inet and udder health of -0.2, DU and fertility of 0.25, and between DU and udder health of 0.3. Daughter group size is 120 for milk, DU, udder health and fertility. For calving ease and maternal calving performance daughter group size is 250 and 60, respectively, while the genetic correlation was –0.5.

Figure 1. Scheme on relative weigths of traits in DPS.

Production : other traits = 57 : 43
DU and health traits overlap 14%
CE= Calving Ease, MCP= Maternal Calving Performance