Finnish dairy farmers' selection preferences compared with realized use of AI bulls

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Summary

Artificial insemination (AI) bulls in the Nordic dairy breeding program are selected mainly on the Nordic Total Merit (NTM) where the traits are weighted based on economic importance. Most AI bulls used in Finland are of Nordic origin but the amount of imported semen has increased. Genomic selection has affected the AI bull selection made on farms, where selection is increasingly done rather between groups of certain type of AI bulls than between individual bulls. The number of dairy farms in Finland is going down while the total milk production has stayed the same. In this new production environment it is interesting to investigate if farmers have breeding preferences that differ from the Nordic breeding program. The aims of this study were to 1) investigate the breeding preferences of Finnish dairy farmers for both main dairy breeds in Finland: Ayrshire and Holstein and 2) compare the breeding preferences of farmer to the realized AI bull selection. Farmers were asked about their breeding preferences on eight different traits or trait groups (production, health, fertility, calving, functionality, longevity, conformation, and feed efficiency). All alternatives were compared pairwise with each other using analytic hierarchy process (AHP). The final data consisted of answers from 340 Ayrshire farmers and from 255 Holstein farmers. The order of preference for the traits was similar for both Ayrshire and Holstein farmers. Health was considered to be the most important trait. Longevity and fertility followed, both being slightly more important among Ayrshire than Holstein farmers. Functional traits and conformation traits followed with quite similar preference. Holstein farmers put more emphasis on yield than Ayrshire farmers. Feed efficiency and calving were assessed to be the least important traits. In realized AI bull selection longevity was also highly emphasized but the health traits (udder health, claw health and other diseases) had quite low average EBVs. Udder conformation and yield were highly emphasized in realized AI bull selection but on stated preferences these traits were among the least preferred traits.

Keywords: dairy cattle, farmers breeding preferences, realized selection, analytic hierarchy process

Introduction

Finland, Denmark and Sweden have been running a joint Nordic Cattle Genetic Evaluation (NAV; Aarhus, Denmark) since 2002. The Nordic Total Merit Index (NTM) that has been used since 2008. NTM is guiding the selection and use of artificial insemination (AI) bulls. The traits in NTM are weighted according to their economic importance in the Nordic production environment with the weights assessed separately for each dairy breed (Kargo et al., 2014). The index weights are also tuned by farmers' opinions, societal needs and consumer preferences to get the final NTM weighting.

The semen doses of the Nordic AI bulls to the farms is sold by VikingGenetics (VG; Randers, Denmark) which is selling also semen from outside the Nordic countries. In the recent years the market has become more diverse with new domestic and international companies providing semen and reproductive services. The amount of imported Ayrshire and Holstein semen

doses from outside the three Nordic countries has notably increased in the period from 2003 to 2015 (Animal Health ETT, 2016). Parallel changes in the use of AI bulls from outside the Nordic breeding program can be seen in the bull selection made on farms. Apart from the changes in semen market the global developments of genomic selection and reproduction technology have driven changes in the breeding programs.

Rapid structural changes on Finnish dairy farms have occurred in recent years with steady acceleration. The current number of dairy farms is less than half of the number in 2000, while the total milk production received by the dairies has practically stayed the same (Ahlstedt et al., 2015). In the same period, the number of dairy cows per milk recorded farm has more than doubled (from 17.1 of 2001 to 36.0 of 2015) (ICAR, 2015). In the new and constantly changing breeding market it is interesting to investigate if farmers' selection preferences differ from the NTM guided selection.

Changes in farmers' breeding preferences have been observed in other countries. In Australia Martin-Collado et al. (2015) used cluster analysis (CA) for farmer questionnaire data and found distinct groups among Australian dairy farmers with either Production, Functionality or Type-focused selection. A similar kind of CA was used in Denmark for farmer questionnaire data to identify differences in organic farmers' breeding preferences (Slagboom et al., 2016). Four groups were identified: Health and Fertility, Production and Udder Health, Survival and Fertility, and Production.

Neither of the two described analyses studied the realized usage of AI bulls. Interest to buy a product surveyed by questionnaires may differ from the realized purchase. The farmer may not always use AI bulls that fit best the farm's breeding goal. The difference between intention and purchase may derive for example from semen price and availability and marketing of bulls. Thus questionnaire surveys may describe the farmers breeding preferences better than the realized usage of AI bulls.

The aim of this study was to 1) investigate the breeding preferences of Finnish dairy farmers for the both main dairy breeds in Finland: Ayrshire and Holstein and 2) compare the stated breeding preferences with the realized AI bull purchasing.

Materials and Methods

Stated preferences

An online survey was conducted via Webropol software to collect data on Finnish dairy farmers' selection preferences. An email invitation to the survey was sent to farmers that had used Ayrshire or Holstein AI bulls during 2015 in their herds. The email addresses of 3 814 herds were provided by Faba (Hollola, Finland). The survey was also promoted in Faba's electronic newsletter and social media (Facebook). The survey was open from 9th of September to 3rd of October 2016.

Farmers were asked about their selection preferences for eight different traits or trait groups (Table 1). All alternatives were compared pairwise with each other using analytic hierarchy process (AHP) (Saaty 1977; Saaty 1980). This method allows respondent to make complex decisions and it is widely used in many fields. The respondents were asked to judge pairwise how much more important a trait (group) is from another on a scale from 9 to -9 with 1 representing equal importance. There were altogether 28 pairs to compare.

The online survey had 657 answers. After removing the invalid answers the final data consisted of 595 answers: 340 by Ayrshire farmers and 255 by Holstein farmers according to the main breed in the herd.

Geometric mean is most commonly employed in aggregating the individual judgements in AHP because the scale is multiplicative instead of additive (Aczel and Saaty 1983,

Saaty 1980). Geometric mean of individual judgements for each trait or trait group for both Ayrshire and Holstein herd groups was calculated. The geometric means were placed in an upper triangular of a comparison matrix (8 x 8). A complement of each geometric mean was placed on the lower triangular of the matrix. The matrix was normalized by dividing each entry by the column sum.

Table 1. Pairwise compared traits or trait groups.

Trait or trait group	**Description**
Yield	Milk, fat and protein yield
Health	Udder, claw, metabolic and reproductive health and young stock survival
Fertility	
Calving traits	Calving difficulty and calf survival
Longevity	
Functional traits	Milkability and temperament
Conformation	Udder conformation, feet and leg conformation, and frame
Feed efficiency	How efficiently cow uses feed energy to milk production

A priority vector shows the relative importance among the compared traits or trait groups. Priority vector was calculated as an average of each row in the normalized matrix.

A consistency measure was calculated by multiplying a row from the comparison matrix by a column of priority vectors and dividing this value with the corresponding row average from the normalized matrix. The consistency measure should be larger than the size of the matrix, in this case 8 which it was for all eight trait or trait groups for both breeds.

A consistency index (CI) was calculated as

(1)

where λ_{max} is the principal eigenvalue and n is the size of comparison matrix, in this case 8. A principal eigenvalue was obtained from the summation of products between each element of the priority vector and the sum of columns of the comparison matrix.

Consistency ratio (CR) was calculated as

(2)

where RI is a Random Consistency Index given by Saaty (1980) (in this case of 8 compared traits it is 1.81). CR should be ≤ 0.1 for the evaluation to be consistent. In this case the CI was 0.003 for Ayrshire farmers and 0.003 for Holstein farmers so the evaluation was consistent.

Realized AI bull selection

Insemination data from Finnish milk recording herds for the year 2015 (provided by Faba co-op, Hollola, Finland) was used to analyze the realized AI bull selection. The final insemination data included 475 015 insemination records where an Ayrshire or Holstein AI bull was used in artificial insemination or in embryo flushing. Ayrshire and Holstein bulls used at least in hundred inseminations were kept in the data. The estimated breeding values (EBVs, provided by NAV) for the 14 individual or composite traits included in NTM were used in the analysis. The final data consisted of 176 Ayrshire bulls (212 675 doses) and 232 Holstein bulls (196 317 doses).

A herd's profile for the use of bulls (herd's breeding profile) was expressed as a mean of each trait's EBV of the used bulls across all inseminations in the herd. This was done separately for the breeds. For the Ayrshire and Holstein farmers answering to the survey the realized AI bull selection was calculated as an average of herds' breeding profiles.

Expected genetic superiority

For both breeds, annually 3 % of the 3 000 genomic tested bulls are selected for semen production in the Nordic breeding program (VikingGenetics, 2016a; VikingGenetics, 2016b). This corresponds to a selection intensity of 2.27. Expected genetic superiority (NTM selection) in the next generation for the 14 traits was calculated based on the selection intensity, standard deviation and correlations between the trait and NTM (Anders Fogh, personal communication, 11.9.2015).

Results and conclusions

The AHP analysis for all Ayrshire and Holstein responded farmers showed that the order of preferences for the eight traits or trait groups was similar for both breeds (Figure 1). Health was the most important trait when selecting AI bulls. Longevity and fertility were also highly emphasized in farmers' selection preferences, both being slightly more emphasized by Ayrshire than Holstein farmers. Functional traits and conformation traits followed with quite similar preference. Yield followed with Holstein farmers putting more emphasis on this trait than the Ayrshire farmers. Feed efficiency and calving were rated to be the least important traits in choosing AI bulls.

Figure 1. Stated breeding preferences among Ayrshire and Holstein farmers.

When comparing the results of the AHP analysis to the realized AI bull selection (Figures 2 and 3), health was considered to be the most preferred trait but in the realized AI bull selection the health traits (udder health, claw health and other diseases) were prioritized quite low among all the 14 traits included for both breeds. Longevity was much favored having the highest average EBV among Holstein herds' breeding profiles and the third highest among Ayrshire farmers. Udder conformation and yield were emphasized a lot in the realized AI bull selection for both breeds but on stated preferences these traits were among the least preferred traits.

The results point out that on both breeds conformation and yield were emphasized more in realized AI bull selection than what the farmers say they prefer. Also health and fertility were prioritized less than what was stated according to the results of AHP analysis. The expected NTM selection resembled farmers' preferences more than the realized selection. Farmers said they chose or would have liked to choose AI bulls that correspond to the Nordic breeding goal but ended up choosing AI bulls that gave better conformation and production than what was preferred and on the other hand poorer health and fertility than what was preferred.

Figure 2. Realized selection on among Ayrshire farmers answering the survey and expected genetic superiority based on NTM selection.

Figure 3. Realized selection on among Holstein farmers answering the survey and expected genetic superiority based on NTM selection.

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