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Breeding Goals for Organic Dairy Farming in Denmark Based on the Principles of Organic Agriculture

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Summary

Organic dairy farming (ODF) is different from conventional dairy farming in management practices, but so far the same breeding goal (BG) is used, based on the same economic models (EM). However, ODF is based on the principles of organic agriculture defined by the IFOAM, which are not easily interpreted in economic terms and it may be questionable to use a BG for ODF based on EM. In this study we set up three BGs for ODF in Denmark, one based on the principles of organic agriculture, one focusing on roughage consumption and feed efficiency, and one focusing on disease resistance. A questionnaire and desired gains index were used to set up the BGs. Correlations between these BGs and BGs based on EM were low. Which BG would be best suitable to use for ODF in Denmark depends on preferences of stakeholders.

Keywords: breeding goal, organic farming, dairy cow, correlation, economic models

Introduction

The Nordic Total Merit index is the breeding tool for all farmers in Denmark, Finland, and Sweden (Kargo et al., 2014). Even though organic dairy farming (ODF) is different from conventional dairy farming (CDF) in management practices, the same breeding goal (BG) is used for ODF and CDF, based on the same economic models (EM). When different traits are found to be more or less important in ODF and CDF, it might be beneficial to create separate BGs. However, the potential for multiple BGs in Denmark has been scarcely studied. The reason for this is that the correlation between BGs for ODF and CDF within Denmark is assumed to be above the so-called break-even point. In populations of a million cows it has been shown to cause a loss of genetic gain when breeding towards two different goals with a correlation above the break-even point of about 0.80 (Banos and Smith, 1991; Smith and Banos, 1991; Mulder et al., 2006). So far, studies into the break-even point mentioned above used the principle of progeny testing bulls. The use of genomic information in dairy cattle breeding may have changed the break-even point so that multiple BGs are advantageous even for correlations between BGs higher than 0.80. Differentiated breeding goals for ODF versus CDF may also be important for CDF to accept the selection index as being relevant for their own circumstances. Failure to accept the national index could lead to ineffective selection approaches based on specific subsets of breeding values.

Breeding goals based on EM were derived for ODF and CDF in Denmark by Kargo et al. (2015). The correlation between these two BGs was nearly one (Slagboom, 2015). However, ODF is based on the principles of organic agriculture (POA) defined by the IFOAM (n.d.): the principles of health, ecology, fairness and care. These principles are not easily interpreted in economic terms, and it may be questionable to use a BG for ODF based on EM. A BG based on the POA can be set up by use of a desired gains index. Correlations between BGs for ODF and CDF may then be lower, and higher genetic gain may be achieved with different BGs for ODF and CDF. In this study we set up three BGs for ODF in Denmark, one based on the POA, one focusing on roughage consumption and feed efficiency, and one focusing on disease resistance. These last two BGs were set up because ODF is characterized by a higher focus on conversion of roughage and preventive health care.

Material and methods

Three BGs for ODF were set up: BGOrgPrin, a BG based on the POA (IFOAM, n.d.); BGFeed, focusing on roughage consumption and feed efficiency; and BGDis, focusing on disease resistance. A questionnaire was sent out to farmers, researchers, and experts in the area of organic animal production to interpret the POA. The participant was presented with a short introduction of the project and with IFOAM's official definition of the four POA (IFOAM, n.d.). The participant was then asked whether a number of given traits (Table 1) were not at all, somewhat, or very much related to each of the POA. Beef production was not included in the questionnaire but was regarded to be similar to milk production in terms of relatedness to the POA. The percentage of participants answering that a trait was very much related to a principle was used to determine which traits needed extra genetic gain for BGOrgPrin. All traits except for cow and heifer fertility and milk production (and beef production) were very much related to the POA according to the participants of the questionnaire, and therefore these traits needed to reach significant genetic gain for BGOrgPrin. No genetic decline was accepted in any of the other traits for all three BGs set up in this study. For BGFeed the aim was to reach extra genetic gain for roughage consumption and feed efficiency. For BGDis the aim was to reach extra genetic gain for mastitis, hoof and leg diseases, and other diseases. Genetic parameters from literature were used to develop an optimization program in R to calculate index weights for all traits that matched desired genetic gain for each BG. These desired gains resulted in index weights shown in Table 1. The correlation between BGs were calculated, using the formula from Buch et al. (2009). In addition, correlations were calculated between the three BGs set up in this study and the BGs based on EM for ODF (BGOrgEc) and CDF (BGConvEc) in Denmark set up by Kargo et al. (2015).

Table 1. Index weights for BGOrgPrin (principles of organic agriculture), BGFeed (roughage consumption and feed efficiency), BGDis (diseases resistance), BGOrgEc (organic based on economic models), and BGConvEc (conventional based on economic models).

Trait	BGOrgPrin	BGFeed	BGDis	BGOrgEc[1]	BGConvEc[1]
Cow fertility	36.29	94.34	0.00	24.19	167.82
Heifer fertility	0.00	0.00	0.00	36.27	32.44
Calving difficulty	-60.98	-50.81	-76.22	-254.07	-264.64
Calf mortality	-21.05	0.00	0.00	-60.14	-74.87
Cow mortality	-28.16	0.00	0.00	-704.07	-836.75
Hoof and leg diseases	-18.83	-25.10	-167.36	-20.92	-16.06
Mastitis	-26.36	-22.59	-225.95	-150.63	-81.06
Other diseases	-9.45	0.00	-141.78	-47.26	-28.52
Milk production	4.35	0.00	217.31	2173.05	1965.83
Beef production	40.00	56.00	120.00	0.00	0.00
Feed efficiency	77.62	211.68	0.00	705.60	559.52

Roughage consumption	15.00	120.00	0.00	0.00	0.00

[1] Set up by Kargo et al. (2015), based on economic models (EM)

Results

Correlations between BGs are shown in Table 2. Correlations between the different BGs were all lower than 0.80, with the exception of the correlation between BGOrgEc and BGConvEc.

Table 2. Correlations between the different breeding goals (BG) set up in this study and the study by Kargo et al. (2015).

	BGFeed	BGDis	BGOrgEc[1]	BGConvEc[1]
BGOrgPrin	0.767	0.666	0.313	0.331
BGFeed		0.314	0.548	0.553
BGDis			0.262	0.296
BGOrgEc[1]				0.996

[1] Set up by Kargo et al. (2015), based on economic models (EM)

Discussion

The correlations between the three BGs set up in this study and the BGs based on EM set up by Kargo et al. (2015) were all below the break-even correlation point, below which it is more beneficial for genetic gain to create lines with different BGs in a population. The correlation between BGOrgEc and BGConvEc were almost unity, as was also shown by Slagboom (2015), so EM for ODF and CDF did not differ much. Choosing which BG to use for ODF depends on the environment and what traits are thought to be important by the farmer, breeding organizations, or other stakeholders. When purely EM are used, a genetic decline in certain functional traits is inevitable, due to a high economic value of increased milk production and unfavorable genetic correlations between milk production and functional traits. Such a BG does not comply with the POA, and thus an alternative BG may be needed. The BGs set up in this study could be an alternative, but the question is whether these BGs will give enough genetic gain in production traits. Previous studies have shown that among Danish dairy farmers, organic farmers wanted to put more emphasis on production traits than conventional farmers did (Slagboom et al., 2016a; b). A tradeoff between economics, the POA, and other important aspects needs to be considered when choosing which BG to use for ODF. To assess usability of the BGs in this study, stakeholders' opinions on these BGs are necessary.

A BG based on the POA has been set up in this study with the use of a desired gains index, and the input of experts in the field of ODF by means of a questionnaire. In addition, one BG focusing on roughage consumption and feed efficiency, and one BG focusing on disease resistance have been set up. These traits were chosen as they reflect typical characteristics of ODF that are in line with the POA. The participants of the questionnaire in this study answered that roughage consumption and feed efficiency were very much related to the principle of ecology, and that the disease and mortality traits in this study were considered to be very much related to the principles of health and care. Therefore, it makes sense to put extra emphasis on

these trait groups, when one of the principles is thought to be more important when setting up a BG for ODF.

Conclusions

This study showed that BGs based on the POA, roughage consumption and feed efficiency, and disease resistance have low correlations with a BG for ODF based on EM. Which BG would be best suitable to use in ODF in Denmark depends on preferences of stakeholders throughout the food system.

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