Animal breeding in organic dairy farming: an inventory of farmers' views and difficulties to overcome

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Abstract

Currently, most organic dairy farmers in the Netherlands use conventional breeding methods and production stock. In view of the organic objective of closed chains, organic dairy farmers discussed in workshops the desirability and practical merits of different possible scenarios for realizing breeding programmes that are more in line with organic farming principles. Generally, farmers concluded that there is a need for organic breeding practices to support the sector's credibility towards consumers and society. The first step in developing organic breeding practices is to ban the indirect use of artificial embryo reproduction technologies, but there was no consensus on which selection strategies best fit organic principles. Most organic farmers preferred to uphold the familiar breeding structure of index selection and artificial insemination. Since the scale of organic farming remains small, a distinct breeding structure for organic farming will be difficult to achieve. Customizing conventional breeding values and an international co-operation between breeding programmes may be (temporary) solutions. In organic farming, farm-based regional breeding strategies based on kin-breeding may be more appropriate but farmers lack knowledge of these practices. Also decision-makers need more knowledge on the influence of the (yet not quantified) genotype × environment interaction on the estimation of breeding values for sires when considering organic and conventional farming as different environments. Substantial genotype × environment interaction would support selection under conditions representative for organic environments. It was concluded that realizing distinct organic breeding practices will take time and will require institutional changes.

Additional keywords: animal breeding scenarios, vision development

Introduction

Organic agricultural production in Europe, including the production of food of animal origin, is growing steadily (Anon., 2001b). Between 1993 and 1998 the total area under organic agriculture in Europe increased by almost 30%. The current organic area is about 3.8 million hectares, or 3% of the total European agricultural area. In the Netherlands, organic farming accounts for about 3% of its total agricultural area. The sector's current and predicted growth can be attributed to the broad appeal of organic farming principles (De Wit & Van Amersfoort, 2001) and to the support from government policy (Anon., 2000b; 2001a). There is a risk, however, that the sector will turn to more conventional methods in order to meet the growing market demand, thus compromising its identity. In the light of this it is vital that the sector continues to invest in its own qualitative development.

In conventional agriculture there is a general tendency to control production conditions in order to maximize animals' yield. By contrast, organic agriculture is based on natural processes and closed cycles, which implies equilibrium rather than control and a less intensive land use. Organic production should be tied to the land, with farms preferably being mixed and self-sufficient (Haiger *et al.*, 1988; Baars, 1990a, 1998; Van Veluw, 1994; Alrøe *et al.*, 1998; Nauta *et al.*, 1999). It is hypothesized that animals from conventional breeding programmes are not optimal for use in organic farming and that the genetic disposition of animals should be dovetailed with the organic production system (Nauta *et al.*, 2001).

The reproduction techniques used in conventional animal breeding are also a point of concern. According to organic principles and guidelines, animal production should take account of naturalness, authenticity, animal welfare and agro-biodiversity (Anon., 2000a; Baars & Nauta, 2001). Artificial insemination (AI) and embryo transfer (ET) are commonplace in conventional animal breeding, but these techniques are artificial, depriving animals of natural mating behaviour and negatively affecting animal welfare and integrity (Rutgers *et al.*, 1996; Christiansen & Sandøe, 1999; Haiger, 1999; Spranger, 1999). Furthermore, due to the pressure of competition between breeding companies, the way these techniques have been used has led to a decline in diversity as fewer breeds and founder ancestors are used for reproduction (Roughsedge *et al.*, 1999). Using breeding stock from conventional agriculture directly connects organic farming with the use and consequences of these techniques. In the legislation for organic farming it is stated that ET on the farm is forbidden (Anon., 1999). So at this point organic farming is using double standards.

In order to enhance product traceability and clarity of product origin, policy makers want to establish organic food chains 'farm to fork' (Anon., 2001a). Moreover, organic livestock and arable farmers would like to establish a distinct organic breeding system, partly because of specific requirements regarding livestock characteristics, but also because of their wish to improve the transparency of their system and products.

The organic sector still heavily depends on conventional breeding programmes (Anon., 2000c), although some farmers do breed their own cattle, either as kin-breeders or as users of breeding stock from such kin-breeders (Nauta & Doppenberg, 2002). Kin-breeding is a breeding method by which farmers select breeding bulls from different cow-families in their herd. Every year these farmers select 4 to 5 bulls and use these evenly over the herd, avoiding mating of close relatives (Baars, 1990b; 2002, Nauta *et al.*, 2001). Currently, the impact of kin-breeding practice on the organic cow population in the Netherlands is minimal and organic farmers do not generally regard it as a serious alternative because kin-breeding is expected to increase inbreeding rates.

At the same time, the lack of an organic alternative seems to be an excuse for allowing the use of conventional breeding stock. Animal breeding is not included directly in the international regulations of organic farming (Anon., 1999). New legislation of organic crop seed production, however, is in development (Baker *et al.*, 2002; Lammerts Van Bueren, 2002). In order to support decision-making on organic animal breeding regulations, we initiated a project to develop a vision of organic animal breeding and to define different strategies that are more in line with the principles of organic farming. In this paper we describe some of the possibilities and dilemmas of animal breeding in organic farming.

Materials and methods

The research, which was initiated by the Louis Bolk Institute and supported by the Dutch Ministry of Agriculture, Nature and Food Quality, was participatory in nature, i.e., it was carried out in close co-operation with organic farmers who were considered pioneers in their field (Baars & De Vries, 1999; Baars, 2002).

The research project was started with writing a discussion paper: 'Organic breeding, a way to go' (Nauta *et al.*, 2001). Based on an inventory of animal breeding in organic farming a view on the current situation of animal breeding in conventional and organic farming was presented. The inventory included a study of the literature, interviews with ten organic farmers who were interested in livestock breeding and a questionnaire distributed to all 350 (in 1998) Dutch organic dairy farmers. The interviews focused particularly on the view farmers took on using (indirectly) artificial reproduction techniques and on the use of cows with a high genetic potential for production at their farms. The questionnaire focused on the use of AI bulls (type, breed) and the experience with the offspring of these bulls. There were 160 respondents, covering all types of dairy farming and years of conversion (Anon., 2000c). The paper also presented six different scenarios for organic breeding (see Table 1) that were based on different assumptions regarding more natural breeding (e.g. no ET and AI) and more specific selection (e.g. regional or farm based).

As a second step of the research project six workshops were held in different regions of the Netherlands, where farmers discussed the paper 'Organic breeding, a way to go', including six possible breeding scenarios for organic dairy farming. All Dutch organic dairy farmers (at that time about 450) were invited to these workshops, but only 50 attended. Each workshop started with one or two short presentations in which the main topics were addressed and the structure for discussion was explained. The discussions were held in groups of 5 to 6 persons including a discussion leader who also took notes on the discussion and the different viewpoints. The discussions

Table 1. Breeding scenarios for organic animal production (source: Nauta *et al.*, 2001).

Scenario I. *Conventional breeding*

Organic farmers continue to make use of artificial insemination (AI) bulls from current conventional worldwide breeding schemes and make no demands with respect to taking into account specific organic considerations.

Scenario II. *Conventional breeding without embryo transfer*

Farmers continue to benefit from conventional breeding, on the condition that animals used on their farm are not born from embryo transfer (ET). As a start for this approach, only bulls will be used that are not born from ET. Breeding organizations will be urged to work on a sufficiently large pool of ET-free bulls of good genetic level.

Scenario III. *Conventional breeding adapted to organic agriculture*

Breeding is based on performance data of conventional cattle. To overcome a possible influence of genotype × environment interaction in estimated breeding values (1) additional information is used for the selection of breeding stock for organic farming, and (2) breeding objectives are adapted to organic farming.

Scenario IV. *Breeding based on organic principles*

The organic sector establishes its own breeding and selection of organic livestock. Bulls are selected from organic farms and the daughters of these bulls will be tested on organic farms to estimate 'organic' breeding values for the desirable traits. The keeping and housing of the bulls are based on the rules for organic livestock farming.

Scenario V. *Regional breeding*

A selected group of breeders provides breeding stock and semen for reproduction. These breeders practice family or kin-breeding as described by Baars (1990b). Other farmers use bulls from these breeding farms.

Scenario VI. *Farm-specific breeding*

Each organic farm practises family or kin-breeding. So each farm has its own stock of breeding bulls and its own frozen sperm doses from these bulls. The bulls are randomly mated to avoid close relationships and inbreeding. Cows are served naturally or inseminated artificially.

focused on the different breeding scenarios presented in the discussion paper. Finally, the outcome of each workshop was presented and discussed in a plenary session. At the end of a workshop the farmers were asked to fill in an additional form on the breeding scenarios they personally preferred including their arguments, and if possible to provide a time-scale or suggestions as to how their preferred breeding strategy could be implemented. They were furthermore asked to give their preference for the organic dairy sector as a whole. The farm of each participating farmer was characterized by size of herd, year of conversion to organic, and breed of their cattle.

This paper presents the results of the choices of the farmers and the discussions in the workshops.

Results

The 50 participating farmers had on average 53 milking cows, which was roughly the average size of a Dutch organic dairy herd (55) (De Jong & Van Soest, 2001) and 8 cows less than the average size of a Dutch dairy farm (Anon., 2003). The farmers' average experience in organic farming was approximately 7 years. About 70% of the farms had Holstein-Friesian dairy cattle. The other ones used breeds like Montbéliarde, Brown Swiss, Jersey, Dutch Friesian, Maas-Rijn-IJssel Red and White and Groninger Blaarkop, or different crosses between these breeds. This indicates that the farmers who attended the workshops represented a good average of Dutch organic farms regarding farm size and cattle breeds used. On average they had a relatively long experience in organic farming, since most farmers had converted during the second half of the 1990s (Anon., 2001b; Nauta *et al.*, 2005).

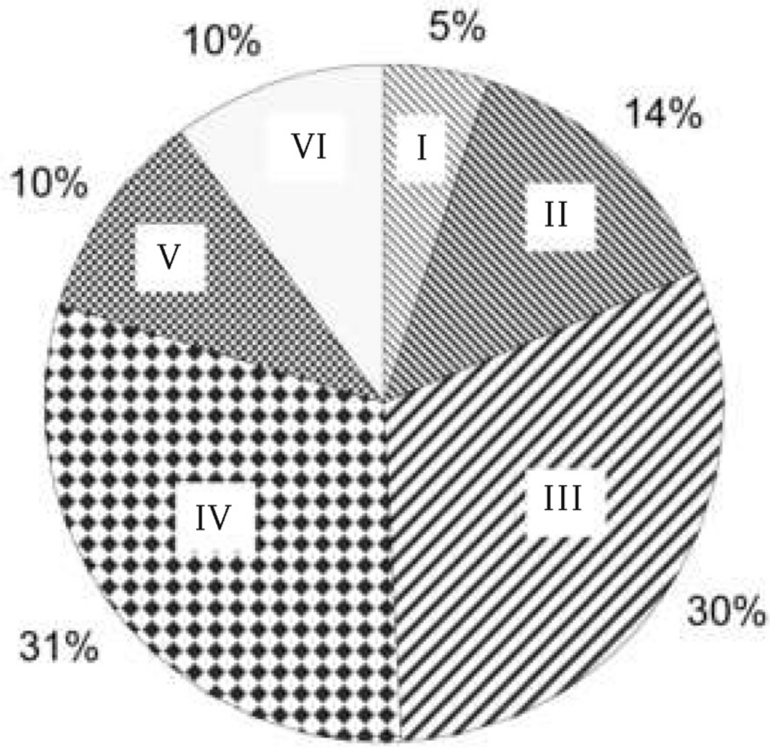

Figure 1. The percentages of dairy farmers choosing the animal breeding scenarios described in Table 1. I = conventional breeding; II = conventional breeding without embryo transfer; III = conventional breeding adapted to organic farming; IV = organic breeding (based on organic data); V = regional breeding (based on kin-breeding); VI = kin-breeding.

Farmers' preference ratings for the different breeding scenarios are presented in Figure 1. Ninety-five per cent of all farmers liked to see a ban on the use of bulls from ET (scenarios II–VI). Fifty-one per cent of all farmers preferred breeding to take place within the organic production chain (scenarios IV–VI). For 60% of this group this meant that breeding and selection should be based on a general breeding approach within organic farming; i.e., that estimated breeding values are based on information from cows that are kept on organic farms (scenario IV). The remaining 40% preferred kin-breeding on organic farms (scenarios V & VI). Overall, farmers preferred a more organic breeding strategy, more or less adapted to or based on organic farming (Table 1; scenarios III–VI).

Farmers questioned the use of conventional breeding schemes. They did not like the use of breeding programmes that are based on artificial reproduction technologies and selection of high-producing animals. In the first place they regarded it as inappropriate to use conventional breeding, because it is contrary to consumers' expectations. Secondly, also their individual motives for producing organically were an important consideration to choose for organic animal breeding.

The use of embryo transfer and artificial insemination

An important reason to ban embryo transfer (ET) was the organic farming's image with consumers. In ET technology, hormones are used for synchronization and superovulation, which is in conflict with organic principles and standards. The general view among participating farmers was that "*consumers are not yet aware about this practice, but we have to work on solutions before they find out*". A ban on the indirect use of ET was mentioned as a first step in the development of a wholly organic breeding system. Farmers did realize that a strict ban would reduce the supply of bulls used through artificial insemination (AI), especially Holstein bulls. It was not clear to them whether conventional breeding companies could produce special ET-free bulls and to what extent this would affect costs and supply.

Some of the arguments in favour of a ban on the use of ET also apply to the use of AI (AI is unnatural and gametes are taken out of their natural environment). Indeed, many livestock farmers considered the possibility of a ban on AI. However, in view of logistic and animal welfare aspects, participants recognized the absence of a practical alternative to AI. In this case, most farmers were very pragmatic, but they also said that they had no choice as long as there was no serious alternative available. Many farmers bypassed AI to some extent by keeping a young bull at the farm for serving heifers.

Among the workshop participants there were two kin-breeders of the Dutch Friesian dual-purpose breed. They actually used their own selected bulls in an on-farm kin-breeding scheme. They were convinced that selecting and using one's own bulls did not have to be a problem. To them it was "*just the normal way of doing things*". They got good results and considered bulls to be part of the system. The use of natural mating bulls has the additional benefits of reduced expenditure on AI and extra income from selling bulls as meat or as breeding stock.

Adaptation of conventional breeding to organic farming

Many farmers (49%) did not see any possibility for a special organic breeding programme. They considered the market too small and the possible selection intensity and supply of breeding bulls too limited. They placed faith in their co-operative breeding company and in the structure of breeding programmes that had been used for several generations. Many farmers did not want to give up this historic social relationship. Should breeding have to be organic, they then liked it to be organized along similar lines.

At the same time, many farmers had doubts about the value of conventional breeding for their own organic farm. They had often observed that pure-bred milk-type Holstein cows with high breeding values for production "*give away too much of themselves*" when kept on an organic feeding regime, i.e., low in concentrates and high in grass with a lower caloric content.

Farmers had also noticed that cows from conventional breeding programmes matured too early. They believed that this was due to selection being too strongly based on the performance of young animals, a criterion used by the breeders to shorten the generation interval. By contrast, organic farming strives for long productive lives of animals so that the animals are used efficiently, also out of respect for integrity of animals. Farmers therefore liked to see breeding strategies and values adapted to organic goals.

Farmers also liked to actually see the bulls so that they could personally approve of the animal. Nowadays, farmers must decide on a bull on the basis of standard photos and index values. Farmers realized that this request might be difficult to honour because of international veterinary restrictions. Smaller, local breeding companies might offer more scope in this respect.

Breeding based on organic standards – 'organic breeding'

The general opinion among participating farmers was: "*We must slowly work towards an organic breeding system but not throw away what we have now*". Many farmers were aware of the need to also include breeding in the organic production chain. However, there was little consensus on how to reach this goal. Many farmers thought that the organic sector was too small for an effective breeding programme. It was not clear how many animals would be needed for a specifically organic breeding syndicate. "*How many bulls can be tested?*" Farmers mentioned the possibility of international co-operation to increase the organic population and the selection possibilities.

Another question for the development of a closed organic chain was whether the housing and management of AI bulls should be organic. Most farmers did not have a clear view on this matter. The general opinion was that "*the regulations for dairy cattle could be applied here*". Organic housing and management for bulls are important to achieve a fully organic chain, but were not considered urgent.

Collective versus individual approach

For most farmers kin-breeding and breeding one's own bulls were not serious propositions. Many farmers were against kin-breeding, using arguments like the danger posed by bulls, the risk of inbreeding depression, slow genetic gain and too much idealism. It appeared that farmers in general no longer have the knowledge required for this breeding system. Some liked to learn more about it. Most farmers had become used to the large stock of selected AI bulls and could not believe that selection in a small population on a farm is possible without inbreeding depression.

Farmers also complained about the distance between them and the breeding organization: they had no influence on decision-making and there were not enough organic farmers to change this situation. With kin-breeding and regional breeding farmers would regain control of breeding. But farmers were also afraid of putting breeding in the hands of a few kin-breeders. "*This was why it went wrong in the old days*" was their argument, referring to the small Dutch Friesian type that was preferred in the 1950s and 1960s in the Netherlands. So kin-breeding, if applied, should be well organized.

Introducing kin-breeding on every organic dairy farm was seen as very unrealistic. Most farmers were not breeders and kin-breeding requires special skills. "*It has to be in your blood.*" a farmer said. In this scenario, breeding would be based only on inbreeding without crossbreeding; heterosis would not be used, which – as one farmer noted – would be rather inefficient. Most farmers saw themselves as commercial users of genetic material rather than breeders of new outstanding genetic material. Cross-breeding between pure-bred lines from kin-breeders at commercial farms would create strong hybrid animals.

Discussion

Our results show that in general the Dutch organic farmers' view on animal breeding is that it has to become more firmly based on organic principles and that it should, ideally, become part of the organic production chain. However, different organic farmers had different preferences, making that there was no consensus on possible breeding strategies in organic farming.

The discussion about breeding was linked to the broader discussion about developments in organic farming. In the 1990s, organic production in the Netherlands grew rapidly as more conventional farmers converted to organic. This resulted in an organic sector that can be seen as a reflection of the conventional sector (Baars, 1998), with many highly specialized and industrialized features (Roep, 2000). Verhoog *et al.* (2003) described three directions of development within the organic sector in the Netherlands. The development of the sector as a whole is aiming for more closed cycles and production chains and is therefore moving towards the agro-ecological and intrinsic approach (Verhoog *et al.*, 2003). Figure 2 shows that animal breeding on a converting farm can be seen as a dynamic and variegated transitional process and can develop along different directions. The development towards organic farming is also a

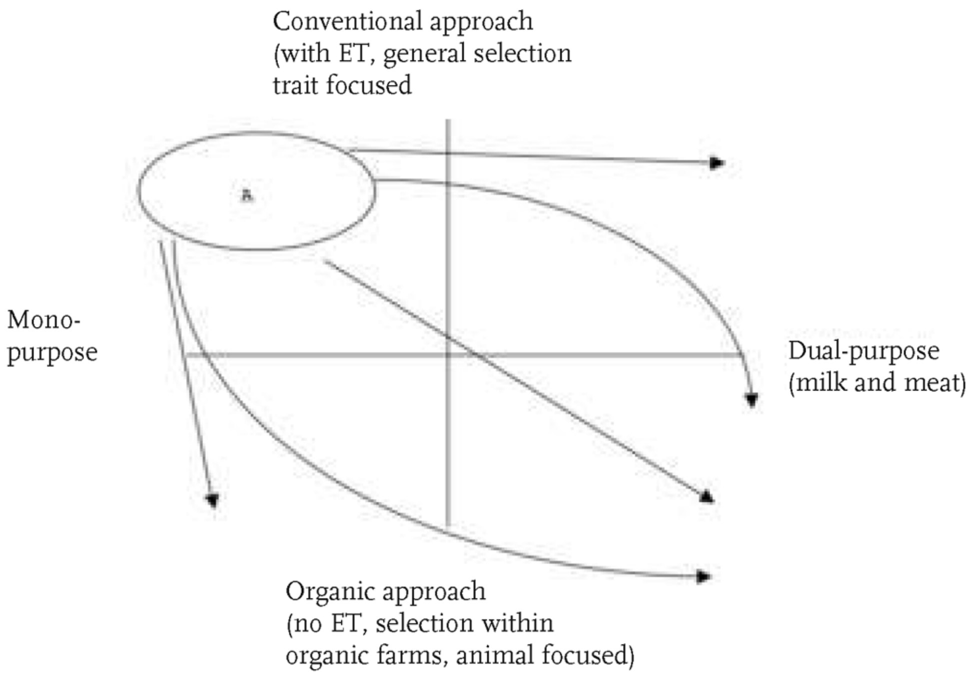

Figure 2. Potential directions of development for a mono-functional farm with a conventional approach (A) converting to a more organic farm and/or a multi-functional approach, based on organic level of specificity.

matter of time (Østergaard, 1997). For example, a farm may have a very conventional symptom-focused approach to organic farming but may grow towards multi-functionality and dual-purpose cattle. But a mono-functional farm (only dairy cattle and milk production) may also develop a highly natural and organic approach without diverting from its single purpose: milk production. The challenge is to develop breeding strategies for organic farming that fit organic principles in general and at the same time acknowledge the actual differences and dynamics of organic farming and animal breeding.

The organic sector as a whole is developing towards a more closed organic production chain, including the input of breeding material. For example, the worldwide umbrella organization for organic farming, the International Federation of Organic Agriculture Movements (IFOAM), is currently implementing the first rules for organic plant breeding (Baker *et al.*, 2002; Lammerts Van Bueren, 2002). Only a few years ago the topic *animal breeding* was included for the first time in the programme of the IFOAM World Conference (Anon., 2000a). Animal breeding for organic farming is expected to become an important issue in the near future. However, there are some important dilemmas to overcome.

Artificial reproduction technologies – naturalness

For most Dutch farmers, a ban on AI is no option. The arguments against AI are very much the same as those against ET. Spermatozoa are taken out of their natural context, diluted and frozen for distribution, natural mating behaviour is excluded and more offspring per bull is created (Spranger, 1999). However, AI was developed to prevent the spread of animal diseases (Den Daas & Van Wagtendonk-De Leeuw, 1993), and – as interviewed farmers noticed – bulls on the farm can be dangerous. So the choice of the Dutch organic dairy farmers is very pragmatic by considering AI as an indispensable technology. On the other hand, some organic kin-breeders did not see natural mating and bulls on the farm as a problem. Experiences of such farmers were studied by Nauta & Doppenberg (2002) and the results can be used to teach other farmers so that they can make new choices regarding farm-based breeding or more collective strategies.

A ban on ET and AI would put the organic sector in a difficult position. It is clear that conventional breeding companies cannot easily provide a special ET-free breeding programme for organic farming: the cost would be too high. In the Netherlands, excluding ET would have a great impact on organic dairy farmers who use Holstein stock (Anon., 2000c; De Jong & Van Soest, 2001). For these farmers the supply of AI bulls would decrease dramatically if ET by descent, i.e., in all previous generations, would be prohibited. However, organic farming is seen as a very natural and animal-friendly production system (Bartussek, 1991; Verhoog *et al.*, 2003) and this is also laid down in the aims of organic farming (Anon., 2002). Internationally, researchers and other stakeholders strive for more natural breeding in organic farming (Haiger, 1999; Spranger, 1999; Bapst, 2001; Bapst & Zeltner, 2002).

A ban on ET would safeguard organic farming from indirectly using other technologies like cloning and genetic engineering. To overcome this dilemma, a ban on ET could be implemented in stages, as was proposed in Switzerland (B. Bapst, personal communication). Breeding companies must consider their possibilities for developing a supply of ET-free bulls. If they cannot provide this, a special breeding programme for organic farmers would have to be developed, especially for Holstein cattle. A survey in the Netherlands yielded 120 ET-free bulls, supplied by five commercial breeding companies (Nauta, 2003). Fifty-four per cent of these bulls still were black and white Holstein and red Holstein, breeds in which normally ET is used. To avoid ET, farmers could also use breeds in which ET is less commonly used. In Switzerland, for example, only 30% of the total number of AI bulls (mainly Holstein) was produced through ET (Bapst, 2002). In the Netherlands, organic farmers use also breeds like Jersey, Brown Swiss and Montbéliarde (Anon., 2000c). These breeds accounted for 18% of the ET-free bulls on the Dutch list. However, the use of ET technologies in these breeds is on the rise. The percentage of the traditional Dutch breeds Dutch Friesian, Groninger Blaarkop and Maas-Rijn-IJssel Red and White, was about 30%. For these breeds the use of ET is low as they are not popular on the market. These breeds could be a starting point for ET-free breeding. To completely avoid artificial reproduction some farmers select and breed animals exclusively on their own farm (Baars, 1990b; Nauta & Doppenberg, 2002).

Specific organic breeding

Almost 50% of the farmers agreed that there is a need for animal breeding within the organic production chain and 30% saw the adaptation of conventional breeding to organic farming as a starting point for this. At the moment, however, there is no information available on how to customize conventional breeding values for organic farming. In this discussion two aspects are important. The first aspect is the choice of specific 'organic' traits and their weighting in a breeding goal. The introduction of durability traits in breeding indices for conventional farming is increasing (e.g. Vollema, 1998; Van Der Beek, 2003; VanRaden, 2004). Although these initiatives are not specially dovetailed with organic farming, they are a step in the 'organic' direction. The second aspect is the influence of the (yet not quantified) genotype × environment interaction on estimated breeding values (indices) for sires when considering organic and conventional farming as different environments. Examples of special sire indices for ecological breeding are available in Germany (Postler, 1998, Wittenberg, 2003).

The genotype × environment (G × E) interaction is related to the phenomenon that different genotypes (of animals) apparently have different levels of expression in different environments. This is generally modelled by defining the phenotypic expression (P_{ij}) for animal i in environment j as a function of a genotypic component (G_i) plus an environmental component (E_j) plus an interaction component ($G_i \times E_j$) (Falconer & Mackay, 1996). The magnitude of the G × E interaction can be defined as the amount of variance in P that is explained by the interaction component. In dairy cattle breeding it is common practice to ignore the G × E interaction when estimating breeding values of sires from data recorded within one country. In theory this means that estimated breeding values are a composite of both G_i and $G_i \times E_j$. In practice this is not a problem as long as recording environments are uniform and the G × E interaction explains only a small portion of the variance in the records observed. However, if environments (for example conventional versus organic farms) interact significantly differently with different genotypes (in the extreme situation leading to a re-ranking), either the G × E interaction is to be modelled as a (correction) factor when estimating breeding values from records of multiple environments or breeding values need to be estimated from and for its use in single type of environments.

The variance in performance records or durability traits explained by the G × E interaction when considering conventional and organic farms as different environments is not yet quantified (Nauta *et al.*, 2002; Boelling *et al.*, 2003). In the near future, regulations for organic farming will be tightened (Anon., 2002). In particular, further restrictions on the use of conventional concentrates, resulting in an increased price of organic concentrates, will result in a lower energy uptake of cattle in organic farming systems. This will cause a further increase in the differences between conventional and organic environments and therefore will potentially increase the variance caused by the G × E interaction, especially for durability traits (Buckley *et al.*, 2000; Berry *et al.*, 2003).

More information on the G × E interaction could facilitate the choice between a collective or more farm-based and individual approach to breeding in organic farming. Given the size of the organic dairy sector (Anon., 2001a) and the variety of breeds used (Anon., 2000c), the suitability of a general approach within organic farming based on breeding value estimates and progeny testing is questionable. At present the Dutch organic dairy sector comprises 550 farms and about 30,000 lactating cows, about 20,000 of which are Holstein. With such numbers, only a breeding programme for Holsteins with about 35 testing bulls (500–700 inseminations) might be feasible. The Dutch Government's target for the organic sector in 2005 is 10% of total agricultural production (Anon., 2000b). If this target would be realized, it would increase the scope for organic breeding for other breeds too. Today, however, we are seeing a decline in the number of farms converting to organic as markets are unstable and financial support is limited. An international approach could solve this breeding problem.

If the sector does not grow substantially, recording information from conventional farms could be used. Recording information from only extensively managed farms could be used too, possibly minimizing disturbing effects of the G × E interaction on breeding values. Similarly, the estimation of breeding values could be based on a smaller group of farms, for example kin-breeding (Baars, 1990b; Nauta & Doppenberg, 2002), again avoiding disturbing effects of the G × E interaction. Both suggestions, especially the second one, lead to a reduction in number of records used and therefore to reduced accuracy of estimated breeding values of sires.

Postler (1998) described an 'ecological index' for dual-purpose breeds in southern Germany, with production persistence and animal health and vitality as important organic traits. Another breeding strategy that is often mentioned as an opportunity for organic farming is the selection of animals with high lifetime productions (Bakels, 1988). Bakels suggested that selecting for high lifetime production would automatically result in the selection of all the necessary traits for longevity. However, both, the ecological index and the longevity approach lead to longer generation intervals, and therefore slow down genetic progress as one has to wait for three or more lactations to be completed before a breeding value can be estimated.

In line with organic farming principles, kin-breeding on the farm is based on natural breeding and stimulates diversity between farm populations as every environment has its own effect and every farmer his own idea about selection (Nauta & Doppenberg, 2002). In this way the introduction of kin-breeding on organic farms could have a positive effect on the image of organic farming. However, breeding at farm level means that populations are small and genetic progress per trait will be relatively small too (Rendel & Robertson, 1950). For increasing the genetic progress, the kin-breeding approach could also be used by (regional) breeding groups as was suggested in scenario V (Table 1). It seems to be worthwhile to study the possibilities of kin-breeding for organic farming on the bases of the natural character of this system.

Conclusions

A relatively small part of the Dutch organic dairy farmers appeared to have interest in animal breeding, but these farmers were well experienced in organic farming.

We observed a strong wish among dairy farmers for more organic-oriented animal breeding. The farmers were concerned about the public's image of the sector and about consumer confidence. They wanted to guarantee a 100% organic production chain, avoiding the direct or indirect use of unacceptable reproduction technologies in the chain and enhancing the adaptation of animals to the organic farming environment.

On the other hand, we did not find consensus on how a more organic based animal breeding is to be achieved. The development of organic breeding strategies is related to the dynamics of the organic sector, which is in the process of transition towards a production based on organic principles. Organic breeding strategies should be in harmony with these developments.

Development of organic animal breeding requires a restructuring of (conventional) breeding. However, there are practical and institutional obstacles to overcome. A total ban on the use of ET would diminish organic farmers' choice of breeding bulls. At the national level, the sector is still small for an all-organic general breeding strategy with a possible exception for organic Holsteins. For the smaller local breeds, genetic progress would be small. Here an international approach might broaden the possibilities.

Another breeding option would be a more individual approach, like with farm-based kin-breeding. This would avoid the problems of using conventional breeding. However, most farmers did not have the knowledge of kin-breeding and did not feel ready for it. The challenge seems to be how to combine the need for a farm-based selection and a collective approach. If an international approach is chosen, the effects of the genotype × environment interaction on the estimation of breeding value may increase. Further research is required for developing information and tools to support organic farmers in realizing organic breeding.

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