

**Concerted Action**  
**‘Genetic Improvement of Functional Traits in cattle’ (GIFT)**

**Dossier No: PL 96-1758**

*Annual report 1998*

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## **1. Introduction**

The recognition of the importance of functional traits in cattle (health, fertility, metabolic stress, longevity; Groen *et al.*, 1997), and the possible role of animal breeding in avoiding deterioration and possibly improving functional traits has led to research activities in many EU countries. Research focuses on tool development (unambiguous trait definition, reliable trait recording and proper evaluation procedures) and tool implementation (optimisation of breeding programmes including production and functional traits). The state of the art in these areas was reviewed at a workshop in Gembloux (INTERBULL bulletin no. 12, 1996). At this workshop it was decided to apply for EU subsidies to organise an international concerted action on genetic improvement of functional traits in cattle to stimulate an efficient use of resources for scientific work. The EU subsidies were granted and the 3-year concerted action was started January 1997. The objectives of the GIFT concerted action are:

- To bring together researchers and people from breeding organisations from member countries of the EU, and other countries with major interests in cattle production, to develop concepts for breeding of functional traits by defining breeding goals and strategies to achieve the goals;
- To enhance collaborative efforts for the further development of efficient recording systems and breeding value estimation procedures;
- To stimulate the exchange of existing knowledge about the genetic evaluation of functional traits;
- To develop recommendations for breeding programmes for functional traits.

Three main activities are organised to accomplish the objectives of the EU concerted action GIFT:

1. Workshops: four initial workshops on definition, recording and genetic evaluation of traits related to the following groups of functional traits: health, fertility and reproduction, metabolic stress, longevity; an intermediate report workshop and a final report workshop;
2. Visits: short visits for exchange of computer programs, inspection of recording systems; longer visits for enhancement of collaborations on the development of programs/systems;

### 3. Internet activities: installation of a home page.

This 1998 Annual Report summarises the GIFT activities in the second year. Specific attention is paid to the scientific conclusions from the workshops.

## 2. Activities

### 2.1. *Intermediate report workshop, August 23<sup>rd</sup> 1998, Warsaw*

At August 23<sup>rd</sup> in Warsaw, GIFT organised an intermediate report workshop. The intermediate report workshop was organised in conjunction with the 49<sup>th</sup> Annual Meeting of the European Association for Animal Production. The intermediate report workshop was attended by 71 participants, from 22 countries (including three countries from Eastern Europe and three countries outside Europe). Proceedings of the intermediate report workshop were published as INTERBULL bulletin no. 19 (1998), including the 1997 Annual Report and the full papers of the presentations during the seminar.

#### *Business meeting*

In the morning, a business meeting was held to report on the activities and to decide upon the recommendations from the initial workshops on Health (Uppsala, June 1997, INTERBULL bulletin no. 15, 1997) and Fertility and Reproduction (Grub, November 1997; INTERBULL bulletin no. 18, 1998). The 1997 Annual Report on the GIFT activities with the recommendations from the two first initial workshops was sent to all institutes participating in GIFT. In addition, the recommendations were summarised and presented at the business meeting in Warsaw. The participants discussed the recommendations, and in general considered the recommendations to be very useful for implementation in practical breeding programmes that aim at a balanced selection for production traits and functional traits. From the discussion it appeared that many breeding organisations were already aware of the recommendations and had started working on the implementation of the recommendations.

In conclusion, the business meeting approved the recommendations, and it was decided to have these recommendations published in an INTERBULL bulletin for world-wide dissemination of the achievements, in order to

- stimulate the exchange of existing knowledge about the genetic evaluation of functional traits, and
- enhance collaborative efforts for the further development of efficient recording systems and breeding value estimation procedures.

Apart from the recommendations for the implementation of balanced selection for production and functional traits, the initial workshops have identified research areas for further research on the biological and genetic backgrounds of functional traits. It was asked for that GIFT would enhance joint research efforts by participating institutes, for example by joint application of funding.

### *Seminar*

In the afternoon, a seminar ‘Developments in dairy cattle breeding with special reference to functional traits’ was held. The papers give a comprehensive overview of current developments in dairy cattle breeding, from an organisational, industry point of view, from the point of view of desired changes in genetics to meet future demands, and from the scientific point of view on methodology (becoming) available.

McGuirk (Genus, UK) put forward his ideas on the developments in dairy cattle breeding industry. The dairy breeding industry can be traced to the establishment of AI services, and so has a history of approximately 50 years. While the structure of the industry and its links with other services to the dairy industry (inseminations, milk collection, milk recording, dairy consultancy etc) vary somewhat between countries, it is possible to see some general trends. There is a tendency of breeding organisations to take greater control over one aspect of their programmes, that of cow selection. There is evidence that offspring performance is more accurately predicted when dams are tested in a nucleus. The use of nucleus herds facilities has often been associated with “in-house” genetic evaluations, which of course can be done whenever they are required, and using whatever models and parameters are thought to be appropriate. When carried out prior to an official proof release, but on the same data, this enables superior bulls to be brought back early for semen collection. The traits recorded would be those demanded by the breeding organisation. Farmer members could be rewarded financially or possibly through better management information. Currently the breeding objectives followed by each breeding organisation are similar, and these are determined by what the market is prepared to buy. While the emphasis on traits may vary somewhat between countries, companies wish to supply a global market. Looking at this question from a scientific rather than a commercial perspective, evidence of appreciable genotype\*environment interactions would suggest a role for niche marketing. While the larger breeding organisations may to some extent market specific bulls at different markets, they have generally been selected as products from within one programme, rather than the result of pursuing different breeding schemes. Large players, possibly benefiting from economies of scale and an international brand image, are naturally then reluctant to then specifically develop product for particular production systems or climatic conditions.

The presentation by Averdunk (BLT, Germany) gave a very interesting overview of the position of dual-purpose breeds. The overview included a discussion on the definition of ‘dual purpose’, current breeds and their distribution, and the recording of milk, beef and total merit (including functional traits) in dual-purpose breeds. Mentioned advantages of dual purpose breeds included a high organisational intensity with direct use for farmers (engagement), regional concentration of breeds, and increasing international co-operation. Disadvantages of dual-purpose breeds are the selection for multiple (generally unfavourably correlated) traits, uncertainty about agricultural policies, and small farm structure. Averdunk very clearly put forward discussion points: “What is the optimal cow size ?”, “Should all breeds go for the

same (Holstein) goal ?", "Should cows and mankind compete for grain ?", and "What alternatives are available in rural communities ?".

Thompson (Genex, US) illustrated that the North American Holstein Breed has literally taken the world by storm over the last 25 years. However, questions exist regarding the breed's suitability for alternative environments. The US is in the process of migrating to a net profit selection goal and will likely place more emphasis on functional traits (other than conformation) than has been practised in the past. Traits most likely to receive attention are somatic cell information, calving ease, and fertility. Milking speed, disposition, early calf mortality, and individual diseases are unlikely to receive major emphasis. Additional research is needed on factors affecting net profit, genetic markers for increased immunological function, and the suitability of crossbreeding as a method to both improve functional traits and avoid inbreeding.

In his paper, Goddard (University of Melbourne) selectively reviews breeding objectives, genetic evaluation systems, use of individual genes and the design of breeding programs. He concludes, that mastitis resistance, fertility and longevity are important traits, but as much for their effect on milk income as costs. Research on genetic evaluation systems is focusing on use of test day yields, international evaluations, non-additive variance, non-linear models and the use of individual genes. Models with a non-linear relationship between traits and possibly censored data (e.g. between milk yield and days open) deserve investigation. Individual genes and mapped QTL can be included in genetic evaluations by use of linear models, combined segregation-linkage analysis or finite locus or gene based models. The use of these genes will lead to the selection of young bulls and heifers to breed bulls, thus reducing generation intervals and increasing genetic gain, but with an increase in variability of response or risk. Methods to make selection more robust to errors in parameter estimates, biased data and bad luck are needed.

In their paper, Hill, Visscher and Brotherstone (University of Edinburgh) discussed the various statistical and genetic assumptions underlying the evaluation and analysis of data on production and functional traits, with the emphasis that researchers should at least be aware of those assumptions. They conclude that there is always scope for small improvements, particularly in the analysis of the increasingly important health and welfare traits. Areas identified in which more research efforts could be beneficial include:

- i. Asking the scientific questions to determine what data needs to be collected.
- ii. Avoidance of heterozygosity loss in the world-wide dairy population.
- iii. Providing more realistic genetic models, including several QTL and polygenes, for analysis of data.

In their opinion, future developments are likely to be in the areas of statistical modelling and analysis. For example, it seems logical to perform a joint statistical analysis of all milk recording data simultaneously, i.e. a multi-variate multi-lactation test-day model. To ensure the robustness of such estimation and prediction procedures with many parameters, methods which take into account the uncertainty in estimated covariance components, e.g. Bayesian analysis, may be needed. More sophisticated analyses using realistic genetic models (e.g. a geometric series of QTL effects) will also be needed, so that phenotypic and genotypic information is used most efficiently.

In conclusion, the above illustrates that at the seminar many important tendencies were discussed, and that suggestions for the balanced selection on production and

functional traits were put forward. But very important, the exchange of ideas gave ‘food for thoughts’ with the participants.

## *2.2. Initial workshop on Metabolic Stress in Dairy Cows, 28-30<sup>th</sup> October, 1998, Edinburgh*

This workshop was organised in association with the British Society of Animal Science and the British Cattle Veterinary Association. The workshop was attended by 109 participants from 15 countries. As the topic of this workshop – Metabolic Stress – is a very complicated topic with aspects covering a broad range of disciplines in animal and veterinary science, the organisation aimed at bringing together an interdisciplinary group of people. The organisation succeeded in having this interdisciplinary group and the great success of this workshop was indeed in the exchange of knowledge among disciplines and the joint effort in putting together suggestions for the reduction of metabolic stress in dairy cows.

The total programme is given in the included Book of Abstracts. This book of Abstracts contains all the abstracts of all invited and submitted papers. Proceedings of the workshop in Edinburgh are in preparation. For this report, it is suitable to present the main suggestions and conclusions for the animal breeding aspects.

The workshop emphasised the idea of looking at the ‘dynamics’ of the dairy cow during lactation. The variation over cows in the course of traits like body weight and body condition score will give an indication of cows being more or less capable of dealing with metabolic stress in addition to the variation in lactation averages, or averages over part of lactations. Variation in dynamics can be studied using covariance functions models and random regression models and the need for studies on using these new analytical techniques was emphasised.

The workshop emphasised the idea of trying to reduce metabolic stress by a complex of traits, rather than independent selection on traits. The complex selection criteria might be called ‘increased ROBUSTNESS of the animals’. Increased robustness should include:

- Breed for cows with an increased adaptive range – a range in which the cow feels well; an important trait for this aspect might be feed intake capacity.
- Breed for cows that show a low incidence of metabolic stress – a situation of stress being characterised as a situation where a cow requires additional metabolic processes to cope with metabolic load in order to stay healthy; important selection traits for this aspect might be observed negative energy balance (from dynamics body condition and live weight) or subclinical disease incidence.
- Breed for cows that show a low incidence of damage, or show low levels of cumulative damage – damage indicates that the cows could not avoid getting diseased from the metabolic load; important traits for this aspect are diseases incidences or reproductive failure.

When proposing the structure of the GIFT workshops, we put together traits like body weight, feed intake capacity and persistency, and we called them ‘efficiency traits’. When working on the programme of the workshop, the scope was broadened with on one hand traits like body conditions, energy balance and metabolic parameters, and on the other hand to well-being of the animals, and we adopted the title ‘Metabolic Stress’. At the end of the workshop this whole group of traits was taken together with fertility and health under the umbrella of robustness of the

animals: cows not only able to produce a lot, but cows that are also able to produce a lot over a long time period without impaired well-being; cows that can cope with metabolic load.

An important discussion point was, whether we want cows that do not show stress, or we want cows that are capable of adequately dealing with stress. This is a very principal point, for which no tailor-made answer is available, but it is an important principle to be discussed when selection is on functional traits.

Currently, animal breeding research should put a major emphasis on the recording and evaluation of the dynamics of body weight, body condition score and feed intake capacity. Prospects of this are in the application of new statistical techniques and increased on farm recording of traits from the application of new information technology (e.g., milking robot).

### 2.3 Visits

In 1998, the EU concerted action GIFT financially supported 5 visits, in which 11 GIFT institutes were involved. Two visits focussed at the use of survival analysis for the evaluation of longevity and fertility. One visit aimed at the analysis of body weight; one One visit more generally looked at possibilities of co-operation and sharing knowledge and data in the area of genetic improvement of functional traits. Most support was given to young scientist, i.e. PhD students and PostDocs.

- T. Druet and Dr. N. Gengler (Gembloux, Belgium) to Dr. J. Sölkner (Vienna, Austria) – intensification of collaborative research between FUSAGx and BOKU on functional traits
- E.P.C. Koenen (Wageningen, Netherlands) to Dr. N. Gengler (Gembloux, Belgium) – statistical analysis of field data on body weight using the covariance/random regression methodology
- Dr. F. Schmitz (Liège, Belgium) to NLH and Tine (Ås, Norway), SLU and SHS (Uppsala, Sweden) and MTT, FABIA and ADPC (Jokioinen and Vantaa, Finland) - - development of health management systems in Belgium
- A. Bünger and Dr. H. Swalve (Göttingen, Germany) to Dr. V. Ducrocq (Jouy-en-Josas, France) – application of the computer programme Survival Kit considering various aspects of modelling longevity
- A. Roth and Dr. E. Strandberg (Uppsala, Sweden) to Dr. V. Ducrocq (Jouy-en-Josas, France) – use of survival analysis for the evaluation of fertility

More details on the visits are in the included reports.

## 2.5. Home page

Directly after the start of the EU concerted action GIFT, an Internet home page was established by the Department of Livestock Sciences, University of Agricultural Sciences (BOKU), Vienna. The home page can be assessed at the following address:

<http://www.boku.ac.at/nuwi/gift>

The home page gives entrance to a lot of information on the EU concerted action GIFT:

- general information (Technical Annex of the EU proposal),
- list of all participating institutes and contact persons,
- possibility of assigning as 'interested person' to receive regular mailings,
- information on forthcoming activities (including registration forms),
- reports on activities.

In 1998, the home page was regularly updated and more people have assigned as 'interest person' receiving all information on GIFT activities.

In 1998, the first computer package was made available via the GIFT Internet home page. The programme is called MTJAAM and is especially designed for the multi-trait evaluation of traits. A multi-trait evaluation increases the accuracy of breeding value prediction, which is especially useful for functional traits as in current breeding schemes the amount of information available on functional traits is generally limited. Via the GIFT home page the source code of the programme, the manual and examples are made available to facilitate use of the programme.

## 3. Conclusion

The EU concerted action 'Genetic Improvement of Functional Traits in cattle' (GIFT) has been very successful in its first two years. Presentations and discussions during the initial workshops have stimulated a further development of accurate genetic evaluations for functional traits. Recommendations were put forward for improving and standardising national and international recording and evaluation of functional traits. Inclusion of partners from both research and breeding organisations gives a short time lag from development to implementation of breeding value estimation programs. Partnership of INTERBULL facilitates a worldwide distribution of the proceedings and results of the EU concerted action GIFT. We are happy to notice that we have established co-operation with well recognised organisations as the EAAP, BSAS and ICAR, for both the organisation of workshops and the presentation of the results of the EU concerted action GIFT.

It is believed, that the EU concerted action GIFT contributes to a sustainable development of cattle production systems, improving animal welfare, improving consumers' acceptance of products and production systems ("healthy food from healthy animals") and facilitating international trade of genetic material.

In the third, final year of GIFT, we will continue our financial support for visits, for making available computer programmes and there will be two more workshops organised:

- Initial workshop on Genetic Improvement of Functional Traits in cattle – LONGEVITY, May 9-11<sup>th</sup>, 1999, Jouy-en-Josas, France;
- Final report workshop on Genetic Improvement of Functional Traits in cattle, November 1999, Wageningen, The Netherlands.

The core-group of the GIFT EU Concerted Action considers it to be a challenge to have participating institutes work together on research proposals for (external) funding of research on functional traits, both fundamental (e.g., on physiological backgrounds) and applied (e.g., practical recording, evaluation and selection programmes). A second challenge is to try to continue the co-operation among the participating institutes (and possibly expand with other institutes) in the important area of genetic improvement of functional traits under the ‘umbrella’ of an international organisation.

## References

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INTERBULL bulletin no. 19, 1998. Proceedings Intermediate report workshop EU Concerted Action Genetic Improvement of Functional traits in cattle (GIFT); Warsaw, Poland, August 23<sup>rd</sup>, 1998, 60 pages.