Metabolic Stress in Dairy Cows
International Symposium organised by BSAS/GIFT/BCVA
Edinburgh, October 28 - 30, 1998

Genetics of Lactation Persistency

Hermann H. Swalve and Nicolas Gengler

Institut für Tierzucht und Haustiergenetik

University of Göttingen

D-37075 Göttingen
Germany

E-Mail: hswalve@gwdg.de

Unité de Zootechnie

Gembloux Agricultural University (FUSAGx)

B-5030 Gembloux
Belgium

E-Mail: gengler.n@fsagx.ac.be

Lactation Persistency - Definition

No unique definition!

Consensus could be:

Ability of the cow to maintain a more or less constant yield in the course of the lactation

Therefore:

The lactation of a cow is more persistent if, for the same total yield, the peak yield is lower and the lactation curve is flatter

Impact of persistency

Improvements when persistency is increased:

- **health**
  - ➔ **less (metabolic) stress ➔ better health**
- **feed costs**
  - ➔ **ratio of roughage : concentrates that is necessary is improved**
- **fertility**
  - ➔ **better fertility when (metabolic) stress is reduced**

Requirement for defining criteria

Criterion should be independent from lactation yield

- economically: yield already considered in the aggregate genotype
- biologically: we wish to define ability of the cow to produce the same amount of milk with less metabolic stress

➔ only very few authors have taken this approach

Criteria that have been suggested

- **Derived from lactation curve functions**
- **Based on ratios of peak/partial/total yields**
- **Variation of partial yields or test day yields**
- **Derived from RR-TDM**
  (Random Regression Test Day Models)

Criteria that have been suggested

Criteria derived from lactation curve functions

- **coefficient of linear regression of test day yield on days in milk**
  (obviously not an ideal lactation curve model)

  ➔ descending phase dominant, slope is negative - Question is: How negative?

- **Wood's curve: $y^t = a\ t^b\ e^{-ct}$**
  Persistency:
  $S = c^{-(b+1)}$

Criteria that have been suggested

Criteria based on ratios of peak/partial/total yields

- involving maximum of test day yields (peak production)
  - mean (or total) / peak
    ➔ higher values = higher Persistency
  - peak / mean
    ➔ lower values = higher Persistency

- involving partial lactation yields
  P3:1, P2:1, P3:2

  ➔ well known, often found

Criteria that have been suggested

Criteria measuring the variation of partial yields or test day yields

- **SD of test day yields:**

  ➔ **not only a measurement of Persistency, but also measuring if “conditions are stable“**

- **yield variation:**

  ➔ **index of variation of partial yields**

Criteria that have been suggested

Criteria derived from
Random Regression Test Day Models

RR-TDM: **model curve by appropriate regression coefficients, allow for covariance structure among them**

Criteria that have been suggested

RR-TDM (cont.)

Proposed RR-TDM (Guelph Group):

- **fixed regressions (nested within age-region, etc.)**
- **random regressions**
- **animal, pe (+ residual)**

RR-TDM produces ‘genetic yields‘ per day or any combination of days

Proposed criterion of Persistency:

- **slope of ‘genetic yields‘ from d 60 to d 280**

Environmental factors

- Herd
- Parity
- Age at calving
- Season of calving
- Gestation
- Other?

Persistency and reproductive performance

- **Before cow gets pregnant:**

  better Persistency is assumed to positively affect reproductive performance

- **After cow is pregnant:**

  pregnancy affects Persistency negatively (non-linear relationship)

Persistency and reproductive performance

Conclusion:

- **the relationship between reproductive performance and Persistency should always be viewed as a two-way interaction**

Lean et al., 1989: ***Cows with high Persistency had lower reproductive performance***

Reasons behind this:

- **rapidly getting pregnant again lowers Persistency**
  ➔ P ↓ Repro ↑
  ➔ Repro ↑ P ↓

Persistency - genetic parameters

Traditional criteria

- **Wood's S, Ratios, SD**

h^2: .05 to .30

r_g with 305-d yield: positive for S and Ratios (around .50)
negative for SD

(positive and negative in a sense of correlated response to selection)

- **Fat and Protein: slightly lower heritabilities**

Persistency - genetic parameters

Criteria derived from RR-TDM (Jamrozik et al., 1998)

h^2: .30 to .40

r_g with 305-d yield: zero !

Persistency - genetic parameters

Genetic correlations among criteria for the same trait:

- very high (close to 1.0)
  even when including SD-criteria

Genetic correlations of Persistency among yield traits:

- .80 to .90

Persistency - genetic parameters

Genetic correlations of Persistency in subsequent lactations:

- very low (.00 to .30)

➔ is this an artefact?

➔ or due to incorrect modelling?

➔ or is Persistency in different lactations really a different trait?

Discussion and conclusions

What are we really looking for?

A cow with

- **high production performance**
- **good health**
- **sufficient reproductive performance (No. of days open according to yield level)**

➔ **not necessarily a cow with a completely flat lactation curve**

➔ **desired: less pronounced peak and good maintenance of high yields**

How to achieve this goal?

- **Management**
  - **use bio-economic models**
  - **optimise feeding, reproductive performance and production**
- **Selection**

Conclusions for genetic improvement

- Reproductive complex has to be included in the models of analysis
- RR-TDM is a very flexible and powerful tool
  - use criteria derived from RR-TDM
  - examine critical part of the lactation
- Evaluate Persistency in the context of metabolic stress

  (definitions of metabolic stress?)

Conclusions for genetic improvement

Will a genetic improvement of Persistency also improve longevity?

- **little is known about this up to now:**
  - **Reents et al. (1996):**
    slightly positive relationship exists
  - **Druet (1998):**
    genetic correlations .20 to .30
- **exploit latest methodology to analyse this:**
  - **survival analysis (SURVIVAL KIT)**
  - **RR-TDM**

Conclusions for genetic improvement

Problem of low repeatability of Persistency has to be solved!

- **is it an artefact?**
- **is it due to selection bias?**
- **is it found only because of incorrect modelling? (reproductive complex mishandled?)**

Important issue for correct lactation curve modelling:

➔ **Multi-lactation RR-TDM**

Conclusions

- Still more questions than answers in the genetics of lactation Persistency
- Needed:
  - more collaboration between geneticists and physiologists
  - better methods and models
  - better data
- Recommendation on the inclusion of Persistency into selection programs is premature